Indian Plague Commission, 1898-99.

MINUTES OF EVIDENCE

TAKEN BY

THE INDIAN PLAGUE COMMISSION

WITH

APPENDICES.

VOL. I.

EVIDENCE TAKEN FROM 29TH NOVEMBER 1898 TO 5TH JANUARY 1899.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1900.

PROCEEDINGS

OF

THE INDIAN PLAGUE COMMISSION.

VOLUME I.

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THE INDIAN PLAGUE COMMISSION.

TE.—Each witness, as far as was possible, put in a précis of the evidence he was prepared to give. The précis, when available, was printed and copies of it were distributed to the Members of the Commission prior to each witness's examination. The précis does not form a part of this record of the Commission's Proceedings, but is referred to in the questions put to witnesses in examination.

At The Secretariat, Bombay.

FIRST DAY.

Tuesday, 29th November 1898.

PRESENT :

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.

MR. A. CUMINE.
DR. M. A. RUFFER.
MR. C. J. HALLIFAX (*Secretary.*)

THE HONOURABLE MR. A. WINGATE, C.I.E., I.C.S., called in and examined.

The Hon. Mr. Wingate.

29th Nov. 1898.

1. (*The President*).—I believe you are Acting Chief bretary to the Bombay Government in the Plague Depart- nt, and also Plague Commissioner?—Yes.

2. You are prepared to give the Commission a general tement with regard to the plague in this Presidency?— will give a short sketch of the spread of plague in Presidency. Plague began in the city of Bombay in gust and September 1896; it reached the district of tara in November, spread to Karachi and Poona and the Thana district in December, attacking the town of rat about February 1897 and the Kolaba and Ratnagiri tricts later on. That means that the spread in the st year was not very wide or very serious. I have here r. Nathan's map,* and from that it will be seen that was chiefly along the coast and in the big towns of ona, Karachi, and Bombay that plague appeared in the st year. I should mention that in the hot season it tacked the coast town of Mandvi in Cutch. By the end of ne the plague had practically disappeared except in tch where it continued to prevail to a certain extent. e state of affairs at the end of June 1897 was exceedingly peful from the point of view of the decline of cases and aths, but the rains, which generally set in by the middle of ne, and are extended over the whole country, during July d August, proved disastrous. Karad, in the Satara dis- ict, Sirur, and Kirki in the Poona district, and Igatpuri the Nasik district, were infected. These places all became ntres of infection, and the attacks occurring in the rains, ade it peculiarly difficult to do anything. They were tacks spread over a large area. Nobody could possibly ve foretold that a town like Karad, for example, would be tacked; but being attacked in the middle of the rains it as almost impossible to do anything. The consequence was that the infection spread quickly and to a very considerable extent in the Satara district. Then by August and September Poona had entered upon its second epidemic, as also, Surat. In October the towns of Ahmednagar, Sholapur, Manmar, and Nasik were infected. I have brought the statement of November of last year and of November of the present year, and I find that by November of last year plague in the Presidency had reached its climax. At that date plague was very bad in most of the towns I have mentioned, and in the Satara district. By November the rains had practically ceased. Evacuation became possible, orders were sent out and large towns like Sholapur, Ahmednagar, Nasik, Malegaon, Manmar, etc., were entirely evacuated, as were many others, wholly or partially. This measure produced an immediate effect upon the mortality, but I think perhaps it was coupled with some seasonal influence, though I cannot say. I always hesitate to attribute positively either an increase or decline to anything that is done in plague. I mention this because this year I observe the same tendency to decline in the Presidency generally about the same time. The evacuation immediately, as I say, produced an effect, and the plague steadily decreased, so that by Christmas time the Presidency was to a large extent becoming free. The city of Bombay in the meantime entered on its second epidemic about the beginning of December 1897, and as that infection increased neighbouring places in the Thana district and other readily accessible places in the Surat, Kolaba, and Ratnagiri districts and in the Baroda State to a certain extent, during February and March, showed an increase. But in all these places, plague, as the hot season came on, declined and by June the Presidency was again getting free. Then, just as had occurred in the previous year, an outbreak during

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* See "The Plague in India, 1896-97" compiled by R. Nathan, I.C.S.
A Map of India is printed as Appendix I in this Volume of the Commission's Proceedings.

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the rains, falsified hopes. The railway quarters constitute a small suburb of the large town of Hubli in the Dharwar district. They had been attacked during October and November 1897 and a few cases had got into the town, but there was not anything to lead to the belief that Hubli could not be saved. The epidemic was fought for a long time, but when the rains came Hubli broke out at once. As from Karad in the previous year plague spread through the Satara district, so from Hubli this year, and from Belgaum, plague crept over the Southern Mahratta country. It is a black soil country, and to a certain extent close to the Ghauts, so it was utterly impossible to resort to evacuation. Now that evacuation has again ecome practicable the orders have gone out again, as they did last year, and we believe and hope that the decline which has already commenced will continue. We have been hopeful this year that the whole of the Gujarat country will resist the plague; but whether it will break out we cannot say. Broach has been threatened for some time, it has not yet got the plague badly, and we hope that the Gujarat country will continue resistant. The exact condition of the plague at the present moment will be seen from this series of maps. There is a map of every district. Each village is not shown, but we have underlined every village that we can in red, so that by turning over the leaves you will immediately get an idea of the extent of the plague at present in the Presidency.

3. Do you intend to put in this paper?*—I will give you a copy of it. Any papers that you ask for we shall be very glad to supply. I should mention, as illustrating the extent of the spread that in the first year, which we close at the end of May 1897, there were 28,737 deaths reported from plague. That is fairly accurate except, perhaps, for the town of Bombay. There we are accustomed to think that the plague deaths have exceeded the reported deaths. Elsewhere in the country I am almost inclined to think sometimes that there are more deaths reported as due to plague than is, perhaps, actually the case, because the people who report (the village officers) have no medical training, and they are naturally inclined to save themselves by putting down all deaths as due to plague. In the next year ending 27th May 1898 there were 61,219 deaths. The increase was largely due to the increase in Bombay and to the great spread of plague in the district of Satara. This year, as far as we have got, to the 25th of November, there have been 61,915 deaths, so that we have already passed the 61,219 of last year. That is due to the very heavy spread in the Southern Mahratta country, Belgaum, Kohlapur, and Dharwar. That part is very deeply infected. These totals seem large; but 151,000 deaths spread over three years in the large Presidency of Bombay does not mean that plague has been particularly bad if you look at it as a whole. If you take particular towns and particular villages, undoubtedly mortality has been serious and that is the tendency of plague. Whether it is in the family or the town, or the district, it has a tendency to nest. Wherever plague is left alone it at once nests, as it were, and gets very virulent and dangerous. The villages that are infected at the present moment number 379, and if we were to exclude the big towns the number of deaths spread over the villages would not be a particularly heavy average. I do not know if this meets your wish as regards a sketch. I could put in a written statement that would give more detail.

4. I am sure it would be very useful. What is the estimated population of the districts involved by the deaths you have given us?—Every week we draw up a little sketch of plague operations, and in the first one we gave a statement of the population of each district. In the Dharwar district the population was 1,051,000 in 1891: now it is probably more. The population of most of the districts varies from about 800,000 to over a million.

5. Can you give us a general description of the measures that have been adopted under your supervision to meet the various epidemics?—The measures have been to a very large extent regulated by local circumstances. The chief measure that we rely on is evacuation, either of the house, the quarter, or the town. The first measure is to ascertain the cases, and that we do by a very careful organization chiefly of native gentlemen, assisted by Government servants, working generally under European officers, who guide and help them. The cases are, as far as possible, taken to hospital, and the people in the infected houses are taken out of the houses. That is the better plan of working in large towns. In the town of Surat, for example, the population of which exceeds 100,000, a very good organization was put in of native gentlemen and Government servants under a few European officers. The town was divided up into wards, and they succeeded in getting nearly every case of plague: most of the cases were ascertained before death. We had a Government Hospital as well, but the people had their own hospital which was excellently managed and very popular. These measures combined with evacuation of specially bad localities enabled the Collector to work the plague through the town of Surat with a comparatively very small mortality, and yet at no time were there more than 10,000 or 20,000 people encamped outside the town. There was no great exodus from the town. There were about 80,000 people, I think, always in the town. There was not the slightest panic or alarm, and the plague passed through, as I say, with a very small mortality. I quote that as an instance of the co-operation of the people in what was done. Another instance of the management of the epidemic was evidenced by the town of Sholapur. There we had a very poor population to deal with. Surat has a rich population, but the town of Sholapur has a poor population. It had passed through a year of scarcity, even amounting to famine, and the population was naturally to a certain extent in a low state of health. There plague got hold of the town and spread with amazing quickness. The Collector decided to evacuate the whole town, which he did. Street by street went outside and they put up shops, and made their arrangements almost exactly as they had them inside the town; every man being next his own neighbour outside, just as he had been inside the town. This evacuation had the magical effect of almost immediately stopping the plague. The whole population were free. Sholapur is a town of about 62,000 people, and they were all got out.

6. Before these measures were taken at Sholapur had the plague assumed any large proportions?—Enormous. It was the most dangerous outbreak perhaps that we had.

7. Was there a large number of cases?—Yes. I have some statistics here. The climax was reached during the week ending the 10th of December 1897, when 501 cases and 436 deaths were reported in that particular week. It is difficult to judge altogether by figures of the severity of plague; one morning the Collector and myself were going round, and we found in just a little corner, a few houses only, that there had been 19 deaths that morning. As I have said plague nests in that way, while the rest of the town may not be so much affected at any particular period,—where it strikes it seems to strike very severely.

8. What was done with the houses which were evacuated?—Every one of them was cleaned, disinfected, limewashed, the roofs exposed, and the doors and windows left open. The whole town was most thoroughly cleaned. That description applies to every single town which was attacked last year from end to end. A great number of the smaller villages were disinfected in the same way; but it was impossible to do them all in the same way, although a large number have been done. Where they were not done the roofs were all taken off, and the whole of the people, with all their belongings, were taken outside. The villages got an ordinary cleaning and the people were kept out until the end of the hot season, when the hot winds that blow on the Deccan are apparently quite enough of themselves to get clear of any plague. We permit the people to re-occupy the villages then, and the results were the same in the villages which had been cleaned and in those which had not been cleaned,—there was no recrudescence. There has been no case that I know of, where a place has got absolutely free from plague and where there has been any recrudescence of plague. Where a population goes back into a village too soon, and there is another case, it is generally due to some concealment amongst the encamped population, who probably take back a case with them.

9. Do you find much difficulty in inducing the population of such villages to go into segregation?—There is no difficulty now. I got a report only last week of a village in the Nasik district in which there had been a good many deaths of rats, and the people of their own accord immediately turned entirely out of the village. The Collector sent down two officers to enquire. The people said they had fever. The officers enquired very carefully into it, but could not find a trace of plague. But the people had all gone out on account of the rats and insisted on remaining out. In the villages in the Thana district, for instance, they go out immediately before any officer goes near them. In all our trained districts as we call them, where they have been through the epidemic and have seen the wonderful effects of evacuation, there is no opposition at all. Down in the Dharwar and Belgaum country, where they have not had any evacuation experience (this is their first year), I dare say they do not turn out quite

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* A volume of "Collectorate Maps of the Bombay Presidency" not printed in the Commission's Proceedings.

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so quickly. These districts usually have very late rains, and some villages have been turned out once or twice, and villagers have had to go back again owing to heavy rain coming on. It is a black-soil country, and heavy rain necessitates a return to their houses. Each time they have gone back they have got plague again. I think very shortly down there we shall have no trouble about evacuation. There is an almost universal concensus of opinion of both officers and people everywhere that evacuation immediately puts an end to plague. In Sind, in the town of Sukkur, there is a section called Gharibabad (town of the poor) where there were a very poor lot of people. All the better class people had gone, and only some 500 remained in isolated houses here and there; but every day there were several cases among this small population of 500. One morning it was decided to take them all out. They were all taken out, but they were so scattered that it took a long time to collect them. They were taken out with their hens, donkeys and everything belonging to them. There was no time to clean up or disinfect anything, yet from that day to this there has never been another case. It is the only case I know where plague has been got rid of in twenty-four hours; and this was in a most deeply infected locality. I cannot quote an instance of so instantaneous a stoppage, but we could quote very many instances of the fact that after a short interval there are no more seizures after a population has been turned out, provided the rules are attended to. Our rules are very simple. The sick people, including the family of the sick, go out on one side of the village, and the healthy people on the other side of the village. If any case occurs among the healthy the case and the family are removed. We do not attempt to separate the families from their sick in the villages. It stands to reason we could not do it if we tried; and it is better to do what we can do than attempt to do what we cannot. An officer will go down to the village, he will find things rather mixed up, but he will induce the villagers to put the huts of the sick in front and the family huts at the back, so that there is an interval of a few yards between the sick and the healthy in the field. That at once produces a certain amount of isolation. If the officer can succeed in preventing the villagers going to their houses at night to sleep, the plague will usually stop. If plague continues in the evacuated population, we are almost certain that there are surreptitious visits to the houses either during the day or during the night. Some Collectors fix a day upon which the population can go back to their houses to get any food and clothes they may happen to have left there. The Collectors find that a good plan, since it prevents the people going back surreptitiously.

10. How long do you generally have a village evacuated before the people return?—If we are able to disinfect the houses the very shortest time would be about three weeks, but it would be very risky. If the rains were near, or if there were any particular reason for doing it, reoccupation could be permitted in about three weeks, provided the houses had been properly disinfected and that the population was free from plague. If there has been no disinfection we like to keep the people out two or three months. That seems to be safe.

11. Of course there must be a limit to that measure. I suppose it would hardly apply to a large town?—I have just quoted a town of 60,000 inhabitants. The town of Ahmednagar was out to a man, and that has a population of nearly 42,000. Then, there is Malegaon, which has 17,000 or 18,000. All these places were absolutely empty, and the houses as I say, dealt with section by section. The people were very carefully allowed to go back again section by section, and we never had another case in these towns. Where there is sufficient ground I do not think there is much difficulty now about getting the people to move, provided there is no rain. The rains are not very heavy in the Deccan districts.

12. Is there anything more you wish to state to us?—You asked how long a village ought to be evacuated. We are anxious to put the people to the very least amount of inconvenience that is possible, but at the same time we have to guard against any possibility of plague breaking out again after the people have been turned out, and so avoid having to do the whole thing over again, which would put them to infinitely greater inconvenience than keeping them out a few weeks longer. But we would like to know accurately how long it takes to get clear of the infection.

13. You cannot apply that to such a town as Bombay?—No, neither in Bombay, Karachi, nor Surat. These are places where there are many rich people and varied trading interests, great trading centres, and you would probably do more injury to the whole country by attempting to stop plague by some drastic plan than by allowing plague to go on under the control which we are able to exercise. Bombay, for instance, is the heart of the whole of the circulation of the Presidency, and if any measures were applied here which paralysed Bombay, either by shutting in its population or by interfering seriously with its trade, it would be felt not only in every part of our Presidency, but a good deal beyond its borders. Therefore in all measures we take we are ruled by those considerations, never to do anything that might do more harm than good. I was only illustrating the advantages up-country and in agricultural towns where the interests of the people are chiefly in their fields around them. They may just as well stay in the fields as stay in the towns. But where you have a population travelling backwards and forwards, and their agents are travelling in every district, we have found that any restrictions put on, (although they may last without causing serious inconvenience for a few weeks, or even longer) very soon tend to produce greater evils than those which they were intended to avert.

14. Apart from that, do you think there is any possibility of adopting any such measures in large towns, looking at the matter only as a question of stopping the plague?—In a town like Bombay with 800,000 people to deal with I do not think it would be possible,—to evacuate the whole.

15. But infected districts, perhaps?—There is quite a possibility of that. I can give you an instance of what was done in the Poona cantonment with great success under Major Ross. Plague was very bad there. It was a small population, only about 24,000,—but instead of evacuating the 24,000 he took out a bad street. He began at the worst street, (perhaps about 800 or 900 people); he would take the people out, disinfect all their clothing, put his soldiers in, and very quickly deal with the whole of the houses, thoroughly disinfect them, white-wash and clean them, and then put the people back at the end of five or six days. I think I am correct in saying that out of some 5,000 people dealt with he only got one, or certainly at most three cases, afterwards, in that quarter, which was a very deeply infected one. Therefore the principle of "quick evacuation and quick back" is quite possible if it can be done under proper supervision.

16. Even on a large scale?—Yes. That is what we hope to do here. Possibly five days would be too quick,—perhaps ten days would do. We hope to be able to act upon that principle freely,—quick out and quick back. In very bad cases we should have to keep them out longer; but, as a rule, I think quick back again is quite safe in towns where the houses can be disinfected under proper supervision.

17. When you do it in that piece-meal fashion in a large place, do you think the general trade and general industry is necessarily injured?—It is not touched at all.

18. The result is also very gratifying?—Very gratifying. No one is at all affected. I would also say that it is extremely popular as far as I know.

19. (*Prof. Wright.*)—Where do the people who evacuate go to?—Bombay is divided up into wards, and there is an officer and a doctor in charge of each. Every officer should have his camp, but as far as the town of Bombay is concerned, one cannot get a site in just the place required. As far as possible, however, every officer has his camp to which he sends his own people backwards and forwards. When that will not suffice, and if plague increases, we have outside Bombay pretty considerable areas where we can take the over-plus.

20. (*Mr. Hewett.*)—I understand that the Government will place before the Commission the District Officers and the Medical Officers who have been actually engaged in carrying out these operations in each of the chief towns; we shall be able to get detailed facts from them?—Yes.

21. Then there is no need to ask any question as to detail?—I do not think so, because they know the details a great deal more accurately than I could possibly pretend to know them. If you would like to call any of the Bombay officers they are available.

22. (*The President.*)—We are very much obliged to you. I do not think we need keep you any longer.

(Witness withdrew)

M. W. M. Haffkine, C.I.E., called and examined.

M. W. M. Haffkine.

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23. (*The President.*)—I think you are attached to this Municipality to do special work in connection with the treatment of plague?—Yes. I serve under the Home Department of the Government of India, and am attached to the Bombay Municipality for doing duty here.

24. In this city or Presidency?—In the Presidency and outside the Presidency.

25. In India generally?—Yes.

26. Are you prepared to tell us what the substance that you use is, how you apply it, to what extent you have applied it, and what have been the general results of that application?—The questions, therefore, are how is what we call the plague prophylactic prepared, how it is administered, and what are the results of the inoculation. The plague prophylactic is not taken from animals as is the case with vaccine lymph, with the material used for inoculation against rabies, or with the serum employed for the curative treatment of diphtheria. It is prepared in an artificial bouillon of the following composition. A certain quantity of minute fragments of mutton is infused in strong hydrochloric acid. The exact proportions of the material are as follows: one and a half kilos of mutton are infused in three litres of water plus two hundred and twenty-five cubic centimetres of hydrochloric acid. As a rule, the material is kept in this infusion for two or three days in the cold. Afterwards it is subjected to a high temperature of 130° to 140° C., which corresponds to about two and-a-half atmospheres of pressure. It is kept at that temperature for six hours. The material is syphoned off and filtered and the solid residue of mutton is rejected and not employed for the inoculation.

27. By filtration you mean?—Firstly, the material is syphoned off, and then it is filtered through paper filters. The temperature to which the material is subjected is such that the organic matter gets partially charred. The liquid is then diluted with a quantity of water which brings the amount I quoted up to four and a half litres. This solution is neutralized with sixty grams of caustic soda and again heated to a temperature equal to the previous one, for only half an hour, then filtered again, and whatever solid residue is produced by neutralization and that second heating is again rejected, and only the liquid part employed. We call this liquid Warden's bouillon. For the cultivation of the plague prophylactic it is mixed with a small quantity of ghee or cocoanut oil, distributed into big flasks, sterilized, and inseminated with a minute quantity of the most virulent plague microbes which we can get hold of. The microbes are specimens obtained in the first instance from a plague patient. Their activity is easily maintained by passages through animals, according to the hydrophobia or cholera process. The liquid inseminated as stated above is kept fermenting. During the first two or three days scarcely any signs of change are observed. Then minute flakes appear underneath the suspended droplets of oil or ghee. These flakes in the course of from 12 to 24 hours grow down in the shape of icicles or stalactites. The liquid remains clear, except for a small quantity of powder-like residue which very early in the process falls to the bottom of the flask. The stalactites in the course of two or three days fill up the upper half, or sometimes even the whole volume of the liquid. The least oscillation of the vessel is sufficient to detach the suspended icicles from the drops of ghee or oil, and the whole growth in the course of a day or so falls to the bottom of the flask, while the liquid appears again perfectly limpid. This stalactite appearance of the growth has an utmost importance, as there are no other microbes up to now known capable of giving the same, and, on the other hand, there is no plague microbe, of whatever origin or previous history, which up to now has failed to show that characteristic. The stalactite growth offers thus one of the best methods known in bacteriology for identifying the nature of a microbe. After the first growth of stalactites has been brought down by shaking, a new crop of flakes appears underneath the droplets of oil or ghee. The same process as described above is repeated again, except that it may be a little slower in development. After another two or three days the flask is again shaken, and the second crop brought down. This process is renewed ten or twelve times. The development takes from 5 to 6 weeks before it is perfectly accomplished. The growth becomes slower and slower, until it stops entirely. In the course of this process the liquid is modified under the influence of the vegetable microbe, in the same way as is modified an ordinary soil inseminated with the seeds of a plant. While the growth goes on, the vegetable destroys the nutritive element in the liquid; and the remainder of the animal matter which has not been changed by charring and all the previous preparation is gradually decomposed and utilised for the growth of the microbe. Towards the end we have accumulated at the bottom of the flask a large amount of vegetable matter grown at the expense of the compound medium described above. The liquid is exhausted, its nutritious elements having been incorporated in the bodies of the bacilli. The two elements can now be separated by syphoning off or decanting the transparent fluid, and collecting from the bottom the solid residue. These two elements have different virtues. The liquid itself, although to the naked eye it may appear unchanged as compared with the original bouillon, shows a difference in its physiological power and composition. It will not feed any further growth.

28. (*Dr. Ruffer.*)—Do you say this bouillon was no longer a cultivating fluid for the plague microbe?—Yes. The second modification is that, when injected hypodermically into animals, it produces an attack of fever, but the seat of injection, the tissue of the skin, does not show any marked effect. On the contrary, the vegetable residue, when separated from the liquid and injected subcutaneously into animals, will produce scarcely any rise of temperature, but gives a very marked local effect in accordance with the amount injected. This local effect in general terms consists in the part where the material has been injected getting swollen, painful, reddened, inflamed. The tenderness of the place disappears first; while the induration or nodule remains for a longer time, but is gradually absorbed also.

29. (*Prof. Wright.*)—May I ask what animal you refer to?—These effects have been studied in rabbits; in the case of man the phenomenon is likely to repeat itself. The above is the description of the prophylactic fluid which I have devised for the inoculation against plague. In giving this description I would like to avoid, as much as possible, a discussion of the reasons which induced me to devise this and not another plan for preparing the fluid. The ideas which different experimentors have, as to the essential and inessential circumstances which determine artificial immunity, are widely different. I should like, however, to keep exclusively for my laboratory and for discussion within the walls of my laboratory the theorising which I went through myself when I devised this, and not another, plan of operation. From the results of all my previous studies, I had reason to believe that this liquid contained essential elements for reducing the liability of an attack in an inoculated person, and, if it did not succeed entirely in that matter, for helping the attacked individual to resist death.

30. May I ask what this liquid is? You said there were two constituents: one solid, one liquid. You have spoken of the liquid. Does that mean the solid and the liquid?—I mean the prophylactic as a whole.

31. In what proportion?—In the proportion in which its elements are obtained during the process described above.

32. (*Dr. Ruffer.*)—You mean a culture 6 weeks old; that is, all the micro-organisms, plus the fluid in which the bacilli grew?—Precisely. I had, however, no information whatever on the following four points. The first was: what will be the immediate physiological or pathological effect of this vaccine, as it would be called on the continent, when injected into man? Secondly: I did not know what amount of this material would be required to be injected in a man in order to produce in him any useful increase of resistance against the disease, and whether the amount would not be such as to render the treatment inapplicable, impossible. It was expected by the most competent investigators that the quantity which would be required for producing any marked increase to natural resistance would be such as to be fatal to a man, or that it might necessitate the working out of a plan of many times repeated injections to be extended over a long period of time which would again render an attempt to create artificial immunity impracticable. The third point was: how soon after the treatment the immunity sought for would be established? The fourth was: how long would that immunity last? The subject on whom I first tried the physiological effect of this liquid was, as you will no doubt be prepared to learn, myself. The amount with which I was injected was 10 c.c., of which 6 c.c. were injected into my left flank, and 4 into my right. The symptoms, as far as they were perceptible, were as follows. Three or four hours after the injection my temperature began to rise, and reached the maximum 102⅗°F. in eight and a half hours. From that time my temperature began to fall. At the seat of injection, almost parallel with the development of the fever, a tenderness began to develope, and reached its maximum next morning, which was

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about 15 hours after the time of injection. The region under my left arm, somewhat below the axilla, became tender on pressure, though, in my case, no glandular swelling formed. The seat of the inoculation reddened, and swelled and became so painful that I had great difficulty in getting up next morning. Still I was able to do so, and at no moment was I obliged to interrupt my work. I was inoculated on the 10th January, and on the 11th an important meeting was to be held, presided over by the Director General of the Indian Medibal Service, Surgeon-General Cleghorn. I was able to take part in the meeting, and until my symptoms had entirely disappeared, scarcely any one knew that I had been inoculated, except the operator (Dr. Surveyor) and the Principal of the Grant Medical College, who had witnessed the operation. The fever disappeared between 20 and 24 hours after injection, when my temperature reached normal. The pain at the seat of inoculation, however, lasted for several—four or five—days, and after the pain disappeared the nodule remained for a couple of weeks longer. Those who have studied the effect of the cholera inoculation or of that now introduced against typhoid, will probably find no distinctive feature between the three. It seems that the introduction of microbes under the skin gives rise to a set of symptoms which are uniform, and at the same time pronounced to such an extent that they mask the specific difference most certainly inherent to the microbe used. The result of my inoculation was made known in a letter addressed to the Secretary to the Government of India in the Home Department, and to the Municipal Commissioner of the City of Bombay, and at the same time I made it known to the public that I was anxious to continue the observations on other persons. In the course of the first three weeks, from the 10th until the end of January, several hundred persons of all ages and sexes offered themselves to be inoculated, and the effects were carefully observed on them. In no instance did we see anything which would point to a marked difference from the effect of the cholera inoculation, or which would indicate the possibility of evil consequences to the general health. This result impressed itself so much upon the mind of those who underwent the inoculation or studied its effect on others that in the course of the next few months 8,142 people in Bombay came to avail themselves of the new treatment.

33. (*The President.*)—When was this ?—In the first part of 1897. In this manner we observed and solved the first of the questions enumerated above, that of the immediate symptoms produced by the inoculation of the plague prophylactic in man. I must state that the dose of 10 c. c. used in the first instance was never used again. The dose which we ultimately adopted as the maximal to be given to a grown up man was a quarter of that amount. I was injected with 10 c.c., not because I, at that stage of my investigation, had any reason to believe that that dose was sufficient to produce the desired protection, or that a smaller dose would not be so; but because I reckoned upon smaller doses and wanted to justify myself in using such on other people.

34. (*Prof. Wright.*)—That means 2½ c.c. of the prophylactic ?—Exactly; I shall return to that subject later on. Towards the end of January 1897, *viz.*, on the 23rd, plague broke out in Her Majesty's House of Correction at Byculla, Bombay; and between the 23rd and the 29th, 9 inmates became affected, of whom 5 subsequently succumbed. With the consent of the authorities of the Jail, and of Lieutenant-Colonel Waters, the Medical Officer, on the 30th of January the option of inoculation was offered to the prisoners, and, upon my invitation, about two dozen professors and students of the Grant Medical College offered to accompany me to the Jail and be inoculated in the presence of the prisoners, in order, by personal demonstration, to show them the painlessness and the harmlessness of the operation. In the afternoon of the 30th January the whole of the prisoners, who at that time numbered 327, were collected in the courtyard of the Byculla Jail, and the operation was first performed on those of the outsiders who wanted to undergo inoculation. The prisoners were told that the operation which they had seen corresponded to the method of preventive vaccination against small-pox; and that up to that time no remedy to help a person already affected with plague was known to the doctors; that then there was a likelihood of the persons undergoing inoculation getting a power of resistance against the disease similar to that of persons vaccinated against small-pox; and that those who would volunteer to undergo the operation could do so. The result was that out of the 327 prisoners, 154, or a little below a half, came forward and asked to be inoculated. The dose used on that occasion was 3 c.c. I stated that between the 23rd and the 29th January, nine cases plague occurred in the jail, of whom five subsequently proved fatal. On the 30th January in the forenoon, before the inoculations were applied, 6 new cases occurred, and of those 6, 3 subsequently proved fatal. The inoculations were applied in the afternoon. Afterwards it was discovered that one of the inoculated had also a bubo in his groin at the time and two others developed buboes the same evening, after the inoculation. These three cases among the inoculated also proved fatal. From the next morning, however, a difference appeared between the inoculated group and the uninoculated. The prisoners were, before the inoculation, all under identical conditions: they lived in the same jail, had the same food and the same hours of rest and work. During the rest of the epidemic, which lasted seven or eight days only, they were again left to live under conditions as identical as are possible in a human community.

35. (*The President.*)—They mixed together, I suppose ?—Yes, I presume so. In plague, however, that is not absolutely essential. The difference in their relation to the disease appeared the next morning after inoculation. The facts were as follows. On the 31st January there were two cases of plague amongst the non-inoculated lot, of whom one proved fatal, and there was one case amongst the inoculated, who recovered. On the second day after the inoculation, on the 1st February, there was one case amongst the non-inoculated that proved fatal, and there was no case amongst the inoculated. On the third day amongst the non-inoculated group there was one case again that proved fatal, and no cases among the inoculated. There were no cases at all on the fourth day. On the fifth there was one case amongst the non-inoculated which proved fatal, and no cases amongst the inoculated. On the sixth day, the 5th of February, there were two cases of plague amongst the non-inoculated, of whom one proved fatal, and there was no case amongst the inoculated. On the seventh day, the 6th February, there were five cases among the non-inoculated, of whom one proved fatal, and one case amongst the inoculated that ended in recovery. Thus, from the next morning after the inoculation, there were altogether twelve cases of plague, of whom six proved fatal amongst the non-inoculated, and two cases both of whom recovered amongst the inoculated lot.

36. There were no further cases ?—No, the epidemic ceased after that. The proceeding which I adopted in analysing the above facts was as follows. I drew from this single instance all the conclusions which were possible, and I formulated these conclusions as precisely as I could, considering them, however, as temporary. I will enumerate them immediately, but you should not think for a moment that I dared to admit that the results as observed in this instance were already finally established. The following were those conclusions. The injection of 3 c.c. of the prophylactic seemed to be sufficient to effect the desired protection, no repetition of inoculation being necessary to arrest an outbreak. The question as to what quantity of the prophylactic was required to produce a useful degree of resistance in man received its first preliminary answer. Secondly, that the prophylactic was powerless to resist the symptoms of plague already started, or which developed within a few hours after inoculation.

37. In that quantity ?—Yes, in the quantity used. This conclusion was drawn from the fact that the only prisoners who did not seem to have benefited by the inoculation were the one who had a bubo at the time he came to be inoculated, and the two who developed undoubted symptoms of plague within a few hours after the inoculation.

38. (*Dr. Ruffer.*)—How many hours after inoculation ?—The inoculations were performed between four and six o'clock, and the buboes appeared the same evening.

39. (*Prof. Wright.*)—Where were the buboes ?—In the first instance the bubo was in the groin.

40. It depends which side of the groin ?—Prisoner 672 had at the time of inoculation a painful gland in the left groin.

41. (*The President.*)—On which side was the inoculation made ?— I may find from my records a statement as to where he was inoculated.

42. Was there fever at that time ?—I regret I am unable to tell you.

43. (*Prof. Wright.*)—And the people who developed it the same evening ?—The two others, Nos. 1356 and 2722, developed painful glands in the left axilla the same evening. These two cases have also proved fatal.

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44. You do not know whether they were inoculated on the right or the left side?—I do not know, but it is possible I may find in my records a statement as to that. I repeat that the second conclusion drawn from the Byculla observations was that the prophylactic was powerless to arrest symptoms already started or which developed a few hours after inoculation.

45. (*The President.*)—I understand that you mean in that dose?—Yes, certainly. The next deduction was that not only does the prophylactic do no harm to persons already infected, but that there is the possibility of its influencing the disease in the incubation period, in an individual infected three or four days previously. This conclusion was based on the following consideration. You have observed that from the time of inoculation, day after day, with the exception of one day, the fourth after inoculation, cases of plague occurred amongst the uninoculated group of the prisoners. The incubation period of plague, from the facts collected up to now, appears to be between two and ten days. A large proportion of the 12 uninoculated prisoners were therefore likely to have been infected already on the day when we dealt with the prisoners. Such being the state of affairs in the uninoculated group, and seeing that the inoculated had been living under the same conditions and had the same chances of infection as the uninoculated, I had reason to infer that a similar group were infected in the inoculated also at the time when they were inoculated. Under these conditions, the reduction of the number of cases and the suppression of deaths among them pointed to the possibility of inoculation influencing the disease in the incubation stage.

46. I am not quite sure what are the conditions of prison-life in India, but at home there is no necessity for much inter-communication between the prisoners; they do not necessarily come much in contact with each other. I should like to know from you what are the conditions of prison-life in India?—According to my information, the prisoners here are grouped up into several groups who are kept at work together.

47. (*Prof. Wright.*)—Were they recent prisoners?—It was a long-term jail. The first prisoner attacked had been in jail for six months, others had been there longer. As far as I am aware, I do not think a single one of the attacked prisoners was a new comer, but this can be found out easily from the jail records. The next conclusion drawn from the Byculla experiment was as follows:—the time necessary for the plague prophylactic to produce a useful effect is shorter than in any preventive treatment known, this period being in the anti-cholera inoculation four days, in vaccination against small-pox seven days, in the inoculation against anthrax twelve days, in the inoculation against rabies 15 days, and in the present treatment apparently less than 24 hours. This conclusion was drawn from the fact that the beneficial difference between the inoculated and the uninoculated appeared the next morning after inoculation. The third question which was to be decided was answered in this manner:—the question was: how long will the operation take to produce the required immunity? and the answer was, it required between 12 and 24 hours.

48. (*The President.*)—Is that also the result of your laboratory experiments?—No; we have undertaken controlling experiments on animals, but they have not been finished; it is the result of the fact that the difference in favour of the inoculated became observable from the next morning after inoculation. The last question which I mentioned above as one which had to be decided by direct study in plague stricken communities, as to how long the inoculated person will remain proof against the disease, remained unanswered in this group of observations; and, in order to insure the probability of a more lasting effect, it was decided, whenever possible, to apply repeated inoculations, and to use doses perhaps higher than those mentioned above, which, however, we never did. In sending in these observations to the authorities I added the remark that:—"The above conclusions are temporary and refer only to the teaching of the particular outbreak in question. There remains fully the possibility of further experiments compelling us to modify the above conclusions, though the expectation is justifiable that the general bearing of the results as above detailed will remain unshaken." These conclusions have, moreover, remained unshaken. In all the subsequent observations the facts collected under the strictest possible conditions, which imitated the laboratory experiments to an extent probably not equalled in any other set of investigations, confirmed the conclusions drawn from that first experiment. I am going to give now the history of the subsequent tests. I have mentioned already that within the next few months after the inoculations began in Bombay 8,142 people were inoculated in this city. At least a half of these persons belonged to the better off classes of the population.

49. More than half?—356 belonged to the higher classes; 2,119 to the lowest; and the rest were between the two. I have the exact figures of course in my office. The vast majority of these cases were persons who read newspapers, and who had physicians to consult. Under these conditions the fact of the 8,142 people escaping infection would probably have only a very relative bearing on the question as to the efficacy or otherwise of the inoculation, if it had not happened that out of the 8,142 people 18 did get infected, all natives of India, chiefly of the class of servants, and went through the full course of the disease. Out of the 18 persons 16 recovered, and the two who succumbed had developed unmistakeable symptoms of plague within 24 hours of inoculation. From the history of these two cases it appeared probable, and in one case I know now for certain, that they had symptoms of plague on them already at the time of inoculation.

50. (*Prof. Wright.*)—Did they have buboes?—One of them had no buboes, the other had.

51. What was the position of the buboes?—I am unable to say, but I believe it is possible to give information on this point.

52. (*The President.*)—Perhaps you will give that in your proof when you see it?—Yes.* I have said what was the result of the disease in the 18 cases of plague which were brought to our notice. I have reason to believe that if there were any other cases of plague besides the 18 amongst the inoculated, they must have been very few. What is almost certain is, that there was no fatal case among the inoculated, except the two mentioned. The reason for my stating this is as follows. As I mentioned already, a large part of the persons inoculated in Bombay during the first part of 1897 were literate persons who read books and newspapers and were perfectly aware of the novelty of the treatment, while the vast majority of the rest were their servants. The physicians in Bombay, as was quite right, kept a perfectly open mind with regard to the efficacy of the inoculation. There were exceedingly few who expected any actual good from it. Not only would cases of plague, especially fatal cases, not have escaped our attention or the attention of those who were observing the progress of this work, but, as a matter of fact, whatever seemed to be abnormal in the immediate effect produced by inoculation, even the most insignificant symptoms, were brought to our knowledge with detail and alarm. It took a very considerable time for the people to learn that an occasional rise of temperature above the average, or a severe attack of headache, or some pain in the joints, were not alarming results of inoculation. A case of failure in the shape of an actual attack of plague, specially a fatal attack, was not likely, I believe, under the circumstances described, to escape our knowledge. However, it is obvious that in a large city like Bombay there was no possibility of our instigating a direct enquiry and following up every one of the 8,142 cases inoculated. Somewhat more complete data were obtained with regard to a small group of people included in the above number of 8,142, but who lived a half an hour away from Bombay, across the harbour, namely, in Mora village. The population of Mora when the plague broke out was under 1,000, and out of this number 429 underwent inoculation; the rest remained uninoculated. I am able to state the exact number of persons who were inoculated, because every person who is inoculated gives us a long list of particulars which we keep, and there is no single individual operated upon with the plague prophylactic of whom we have not a full record. But I can state only approximately the number of persons who remained uninoculated. The total number of inhabitants, as stated, was about 1,000. During the course of the epidemic seven persons got attacked amongst 429 inoculated, at different intervals after inoculation, and all these seven recovered. Amongst the uninoculated 26 attacks of plague are reported to have taken place, of whom 24 proved fatal. I quote this instance,

*[Note:—The results of enquiry by M. Haffkine are contained in the following letter to him from Dr. Bejanji D. Kapadia, who treated the case:—In reply to your note I have to inform you that the patient had already slight fever when he was inoculated. You will remember that we were treating his sister at that time in the same house, and he accompanied us in the laboratory to be inoculated. The patient had glands developed in one of his thighs, right or left I cannot say with certainty, but surely in one of his inguinal regions. The patient had already symptoms of plague on him, say commencing plague, at the time of inoculation.]

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because it produced a great impression upon the inhabitants of Mora, and because its influence was reflected upon Bombay. But, owing to the great pressure of work at the time, I could not follow up the cases in Mora to such an extent as to be able to guarantee that the figures are absolutely correct. The first place where a more accurate investigation in a whole community was carried out was Daman, a Portuguese colony within six hours from Bombay. I do not know whether I should be justified in entering into the details of the operations carried out there, as they were described fully in a printed report* put at your disposal. The result of the operations in Daman briefly stated were as follows. The total number of inhabitants at the time of inoculation was over 8,000. The total of inoculated was 2,197, and the number of uninoculated 6,033. The conditions under which the investigations in Daman were carried out will be found in my report, and the extent to which the figures are reliable will be seen from that. You will, therefore, permit me to omit those details, and to state simply the result. Daman and Cutch Mandvi were the two places most severely affected in India during the first year of the plague. At the end of the epidemic, amongst the 6,033 uninoculated persons, there were altogether 1,482 deaths from plague.

53. (*The President.*)—Do you know how many cases?—No, I do not know it.

54. (*Mr. Hewett.*)—It is foreign territory, is it not?—Yes, it is a Portuguese colony. The inhabitants are mostly natives of India, and only a few are Portuguese. The 2,197 persons inoculated were not operated upon in one day, but on three or four occasions; so that 2,197 is not the number of inoculated who went through the whole period of the epidemic. In the first series, for instance, only 1,017 persons were operated upon, and the rest of the population remained uninoculated. In my report the figures and the time during which the proportion of the inoculated and uninoculated remained unchanged are given. After each series of inoculations the number of the inoculated increased and the number of the uninoculated correspondingly decreased. Taking into account the exact proportion of strength, for each period of the epidemic separately, it appears that if the inoculated group of inhabitants had remained after inoculation as susceptible to the disease as were the uninoculated, they should have had 332 deaths from plague. The actual number of deaths was 36, which represents every 100 deaths reduced by 89.

55. (*Prof. Wright.*)—Did the uninoculated belong to the same class of society?—Yes, very greatly so. In a population of 8,000 it was impossible that 2,000 should represent classes which, owing to their superior conditions of life, should be much less exposed to infection than the rest of the inhabitants. In the report, however, closer comparisons are given. A fairly neat instance was represented by the inoculated and uninoculated of the Parsee community. The plague history of 89 households, containing inoculated and uninoculated of the same families, as investigated by Major Lyons, I.M.S., is also given there.

56. Have you considered the questions of the percentage of sick, weakly, and old people?—That was attended to much more minutely than in Daman, in some of the subsequent experiments, which I am going to relate.

57. (*Dr. Ruffer.*)—I understand you have notes about all these cases, so that you will be able to tell us their ages, occupations, and so on?—Yes; certainly.

58. (*The President.*)—This occurred in the first outbreak. Has there been any subsequent outbreak of plague in the same place?—Yes, but to a far smaller extent than the first.

59. Have you worked out the statistics?—No; but that is in view now. The officer, Major Lyons, I.M.S., who carried out the detailed investigations in Daman, is now away on leave, but when he comes back, I intend to request Government to depute him for investigating the further history of the cases.

60. When will that be done?—It is desirable that it should be done after this cold weather, in order that, if there is a recrudescence of plague in Daman, further comparisons could be made between the inoculated and uninoculated. In the next place of observation the inoculations were applied under still stricter conditions. The little town of Lanauli is a hill station within four hours from Bombay on the way to Poona. In the season it has, I believe, some visitors from both of these towns. The first cases of plague occurred at Lanauli during the season. There were, I believe, some 20 cases and then the disease subsided; but in about a month or so, when all the season visitors dispersed, the plague broke out again. The officers in my laboratory and myself went to Lanauli in July 1897. At that time the total population was below 2,000. A large part consisted of railway officers, who lived in separate quarters away from the rest of the population. Their quarters remained almost entirely free from plague, and there were only two wards in the town which got the plague badly, namely, those situated in and close to the old and new bazar in Lanauli. The whole town was divided into four wards, and in accordance with the agreement with the Local Plague Committee and with Mr. Orr, the Assistant Collector deputed from Poona, the officers of my laboratory took over the two severely affected wards, what we called at the time C and D wards,—which, as I mentioned, included the new and old bazar and the streets close to them. We began first of all by taking a detailed census of the population, and I have the investigation sheets referring to each family separately, and giving the ages and sexes and the names and other details of the members of every household. This house-to-house visitation, with the census in our hands, was repeated periodically for several weeks, until the epidemic almost entirely subsided. During the first week inoculation was performed upon the members of the families where cases of plague occurred, and upon the families living in the neighbouring huts, who volunteered for the operation. In the course of that week a little below a half of the total number of the inhabitants was inoculated.

61. Do you know the number?—Yes, quite accurately. When I mentioned just now a little below a half, I must explain that statement. The actual number of inoculated was higher than the number of uninoculated, but the inoculations were performed on several days, and not on one day. In ward C, on the 22nd July, when we began the inoculations, only 35 people submitted to the operation, and 419 remained uninoculated. During that first day three cases of plague occurred amongst the 419 uninoculated, and no cases took place among the 35 inoculated. On the next day, the 25th July, 35 more people were inoculated. The uninoculated were therefore reduced by that number and by the three people who had been taken to the hospital on the previous day, so that the total number of inoculated became 70, and of uninoculated 381. On the 26th, most probably the officers were busy in the other ward, and only three persons were inoculated in C ward. Three cases of plague having been removed on that second day from amongst the uninoculated, the proportion on the third day was 375 uninoculated to 73 inoculated. Day after day the number of the inoculated increased in the following manner—35, 70, 73, 103, 118, 156, 160, and so on, and that of the uninoculated decreased—419, 381, 375, 343, 327, 286, 281, and so on. On the 2nd August the number of inoculated was 220 and of uninoculated 204. The first increased subsequently still a little further and the second decreased, so that on the last day of the observations, excluding all those who had been attacked with plague, the number of uninoculated was only 147 and the number of inoculated 238. But in drawing our final conclusions we considered the incidence of plague amongst the uninoculated as having occurred not in 147 people, but in the *average* of the daily strengths, which was 214. Similarly, the incidence of plague amongst the inoculated was considered as having occurred not in 238 individuals, but in their daily average, 201. A similar procedure, in order to avoid any exaggeration of the effect of inoculation, was adopted with regard to ward D. Putting the two wards together, the number of inoculated was 368 and the number of uninoculated was only 297, but their average daily strength was 323 and 377 respectively. Therefore, although we inoculated more than half of the population, the mortality will be considered as having occurred amongst 323 inoculated only and 377 uninoculated. The incidence of plague amongst the inoculated and the uninoculated was as follows. There were altogether 78 cases with 58 deaths among the uninoculated. The inoculated persons belonged either to the same families as the uninoculated, or belonged to as identical a class of people as can be found in the same lanes and quarters of a small town. If they had had after inoculation the same susceptibility to plague as the uninoculated, they should have produced proportionately to their numerical strength 67 cases of plague with 49 deaths. Instead of 49 deaths they had only 7. That corresponds to 100 deaths being reduced by 85.

62. Can you state the number of cases?—The number of cases which proportionately should have been 67 was 14.

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*See Appendix No. II in this Volume.

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63. (*Prof. Wright.*)—We have here a mortality of 50 per cent. in the patients who took plague after they had been inoculated, whereas in Bombay we have a mortality of only 12 per cent. in the patients who took plague after inoculation?—Yes, that is so.

64. And was the prophylactic which was employed exactly similar in both cases?—No.

65. What was the difference in the prophylactic?—In Bombay we used prophylactic fluid freshly prepared; in Lanauli we used, for the first time, material which had been stored in the laboratory and kept in the hot months in Bombay. Moreover, in Lanauli we used for the first time carbolized materials, that is prophylactic fluid which was intended to be kept and had been rendered safer against subsequent contamination by the addition of carbolic acid. Apart from these differences, however, the prophylactic always differed. In describing the prophylactic I should have possibly stated the details concerning the variation of its properties and the doses used.

66. (*The President.*)—You will give us that before you finish your evidence.

67. (*Prof. Wright.*)—I think it would be more convenient if the difference in the prophylactic were stated in each case?—With regard to this question I would refer the Commission to our Report on Daman.* In Daman a prophylactic of different strengths, and inoculations with different doses, were applied, and the incidents of plague were followed up in connection with the material used and the dose injected.

68. (*The President.*)—I think if you could give us a general statement of the method of selection of the dose of any given sample of prophylactic it would be of great value to us. How do you proceed to fix your dose, as you tell us that your substance varies in each case?—Perhaps you will approve of my delaying this additional explanation until I will have finished with the summary of our observations. After the epidemic at Lanauli the inoculation was tested at Kirki, a military suburb of Poona. The group of people who were inoculated were the native followers of the four batteries of Artillery stationed there. The total number of followers, including males, females, and children, at the time of the epidemic was above 1,500. They lived in 27 Government barracks on an isolated maidan or lawn, more or less away from the rest of the population, and were subject to a strict supervision, during the whole time of the epidemic, on the part of the military authorities and of a special medical staff. The inoculated and uninoculated belonged to an absolutely uniform class of the population. A large number of those inoculated were members of the same families as the uninoculated. The inoculations were applied there also on several subsequent days, and I have here with me an exact statement as to the number of inoculated and uninoculated on each day, together with the incidence of plague and the issue. The summary of those statements, which will be put at your disposal, is as follows. Counting the average daily strength, there were 671 inoculated and 859 uninoculated. The 859 uninoculated had, in the course of the epidemic, 143 cases of which 98 proved fatal. The 671 inoculated, compared proportionately with the uninoculated, should have produced 112 cases with 77 deaths. Instead of 77 deaths we had 17. The number of 77 deaths was therefore reduced by 60, which corresponds to 100 being reduced by 77·9. This is the lowest proportion of difference in the incidences of deaths amongst the inoculated and uninoculated which has ever been observed in the whole series of my experimental operations. The material used here was the poorest, and the doses applied the largest which I have ever given personally. I will refer to the conditions under which these inoculations were done when I speak about the variation of strength in the prophylactic.

69. In this case you have not given us the total number of cases of the inoculated?—Yes, they were 32 cases, with 17 deaths. At the end of December 1897 the plague broke out in the second Bombay jail. There are two jails here, the Byculla House of Correction mentioned already, and the Umarkhadi Common Jail. Three cases of plague, all of which proved fatal, occurred before inoculation was offered to the prisoners. This was done on Saturday the 1st of January, when the prisoners were questioned as to their willingness or otherwise to be inoculated. The whole number of them volunteered. In view, however, of the novelty of the treatment, and with the object of demonstrating its harmlessness and the extent to which it gives protection, only half the prisoners were allowed to undergo inoculation. To avoid making any special distinction the whole of the 402 prisoners present on that day were paraded in ten rows, an officer was put upon them, and every second prisoner, just as they happened to have come and were seated in the rows, was sent to the inoculation table and received the inoculation. We have been emboldened by our previous experience of the after-effect of inoculation not to refuse it to any one who chooses to undergo it. I mean to say, no condition of health is considered to disqualify a person from being inoculated except his having fever or plague on him at the time he presents himself for inoculation. By accident, however, it happened that the officer inoculating noticed that a man had fever on him when the actual injection was already performed; his temperature was taken, and found to be 102°F. While the inoculations proceeded, one came across another man, with an exactly similar temperature, who was left uninoculated. Neither of these two men showed plague afterwards. We quoted afterwards that almost incredible incident in order to emphasize the fact that in every respect the inoculated and uninoculated prisoners appeared to be under absolutely similar conditions, but for the fact of inoculation. It was agreed with the authorities that that day being Saturday and the next Sunday, when no prisoners were expected to work, if any of the inoculated required rest on Monday, the whole number of the inoculated and the uninoculated should be given leave in order that there should not be a single circumstance which could be pointed out as constituting a difference in the conditions of the inoculated and the uninoculated. The observations in the Umarkhadi Jail have, therefore, been made under still stricter conditions than those in the Byculla House of Correction. It is because in this instance every second man has been taken, and because we did not wait for the volunteers coming out of the crowd, as was the case with the first inoculation in the Byculla Jail, that I consider this experiment as having been made in more precise order and under stricter conditions than the first experiment. The whole lot of the prisoners were taken in the order in which they came without any distinction of any kind being made. In the latter instance there still remained the possibility of saying that out of the crowd of 327 prisoners, there must have been a certain number who abstained from inoculation on account of a sickly disposition; or it may be possible that a man who had symptoms of plague upon him did not dare to come forward for inoculation on account of his fears of exposing himself to, perhaps, a risky treatment; or, on the other hand, possibly the most courageous only and those who believed in the treatment may have come forward to be inoculated; and that circumstances of that kind may have created an additional difference between the inoculated and the uninoculated. All these circumstances were eliminated in the Umarkhadi Jail. Not to leave out anything, I must mention the case of two prisoners who were not willing to undergo inoculation, and who were left alone. It happened in two instances, out of the 402 persons who were there, that when their turn came to be inoculated, because they were second in the row, they said they did not wish it to be done, and these two were not inoculated. I consider this experiment in the Umarkhadi Jail as presenting a complete elimination of the errors inherent to observations in human communities generally, I mean to say from the point of view of the precision of the experiment and as regards the infallibility of the results. The results of the treatment of inoculation were as follows. The plague continued for about a month; and on 11 different days there occurred 13 cases. During that month a certain number of prisoners were discharged, and others admitted to the jail. Taking day by day the number of inoculated and uninoculated who remained in the jail during that month of plague, from the original group of 402 prisoners, the average daily strength of the inoculated appears 147, and of the uninoculated 127. The number of inoculated who stayed in the jail all through the epidemic was therefore larger by about one-seventh than that of the uninoculated. All the 13 cases of plague occurred among the prisoners of the *original group* who were present in the jail on the day of inoculation, and no cases occurred in those admitted since then. Therefore the distribution of the cases of plague among the inoculated and the uninoculated represents the distribution of the two original absolutely comparable groups of people which I have described. Ten of the thirteen cases were amongst the smaller number of uninoculated, and six of these ten died. There were three cases amongst the larger number of 147 inoculated, and all three recovered. The symptoms of the disease in these three inocu-

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* See Appendix No. II in this Volume.

lated were such that neither the hospital authorities to whom the plague patients were sent from the jail nor those who had seen and investigated the cases afterwards were sure that these inoculated had actual plague, and it is only because one wished to eliminate any possibility of mistake being made in favour of the inoculated that these three were sent to the hospital and kept under observation until they recovered. The Director General of the Indian Medical Service, Surgeon-General Harvey, visited Bombay at the time when two of these prisoners were still in the hospital; and in his report to the Government of India, dated 19th April 1898, he states with regard to these three cases: "The hospital authorities at Parel were not quite sure that they were cases of plague. If they were, they were so much modified as to be with difficulty recognizable. I saw two of them and they looked to me like *mumps*." Admitting, therefore, that these were three cases of plague amongst the inoculated, the plague was modified to such an extent that the disease was scarcely recognizable, whereas amongst the uninoculated group, smaller in number, there were ten cases of unmistakeable plague, of which six proved fatal. The number of deaths which should have occurred in the 147 inoculated prisoners, if they had been as susceptible to the disease as the uninoculated, would have been proportionately seven, instead of which they had none. I pass now to the next place where the inoculations were applied again under conditions which admitted of an exceedingly strict comparison of the susceptibility in inoculated and uninoculated, and which presented the additional feature of the observations having been made in a community composed of all ages, sexes, and constitutions usual to the free population. This was in a village called Undhera, of about 1,000 inhabitants, within 6 miles of Baroda.* The inoculations in this village were done under the following circumstances. The Baroda authorities made a census of the inhabitants, and at the time when the officers came to carry out the inoculations the whole number of the inhabitants were paraded in the streets in four different rows, family by family. The inoculations were performed by Major Bannerman, I. M. S., Deputy Sanitary Commissioner of Madras, and myself in the presence of a Commission of Civil and Medical Officers of the Baroda State. The inoculating officers went from family to family, and within each of these, as far as it was possible, inoculated a half of the male members, half of the female members, and half of the children. If a family contained 7 male members, and if it happened that in that family 4 were inoculated and 3 left uninoculated, in a subsequent family with an odd number of males, a smaller number was inoculated and a larger left uninoculated. If it happened that of two children in a family one was a sickly and the other a healthy one, and if the healthy child was inoculated and the sickly one left uninoculated, in the next family which contained sickly and healthy children, a larger number of sickly were inoculated and a smaller of healthy left uninoculated. So that as far as was practicable, equal numbers of healthy and of sickly persons, of children, of old people, of male and females were inoculated and left uninoculated. The investigation as to the result of the treatment was carried out by Surgeon-General Harvey, Director-General, I. M. S., Major Bannerman, Captain Dyson, I. M. S., Deputy Sanitary Commissioner of the Bombay Medical establishment, and by a Committee of Civil and Medical authorities of Baroda, and myself. Permit me to read in the words of the Director General the description of the results as he reported them to the Government of India on the 19th April 1898:

"Undhera, a village about six miles from Baroda, was attacked by plague in January 1898. On the 5th February a careful census was taken and showed a population of 1,029. Up to and inclusive of 14th February 79 plague deaths occurred, leaving 950 people to be dealt with. Of these, 513 were inoculated, leaving 437 uninoculated. As far as possible an equal number of each sex, age and family, was done, and as all were living under precisely similar conditions as to sanitary surroundings, food, drink, clothing, etc., the case is the best and most conclusive example yet available of the result of inoculations. Except for the inoculations all were on the same footing, and the disease had got a thorough hold of the place. The usual sanitary precautions as to segregation and disinfection were carried out, plague cases being removed to hospital and every effort made to combat the disease in the usual way. The inoculations were done on the 12th, but the following figures are taken from the 15th, so as to eliminate cases incubating plague at the time of the inoculations. Three deaths occurred among the uninoculated between the 12th and 14th inclusive, none among the inoculated. These three deaths, together with two others which might possibly have been due to diseases other than plague, have been eliminated, so that no exaggeration as to the effects of the inoculation may be possible. The results up to 2nd April are as follows, but no case occurred after 26th March, so that we are probably dealing with a finished epidemic. Between 15th February and the cessation of the disease plague cases occurred in 29 families, living together as already said under exactly similar conditions, save that some were, and others were not, inoculated. These 29 families comprised 135 individuals of all ages, 71 of whom had been inoculated and 64 not. The 71 inoculated had 8 cases with 3 deaths, while the 64 uninoculated had 28 cases with 26 deaths. Had the inoculated been as susceptible as the uninoculated, they should have had 29 deaths instead of 3, and the inference seems irresistible that the inoculation saved 26 lives out of this small number, or 89·65 per cent. Taking the whole number inoculated, 513 had 8 cases or 1·56 per cent. and 3 deaths or ·58 per cent., while the 437 uninoculated had 28 cases or 6·4 per cent. and 26 deaths or 5·9 per cent, just ten times as many. The protective influence of the inoculations is brought out still more strongly in some particular instances. Thus in hut 84, ward 4, 5 persons were inoculated and 5 uninoculated in a family of ten. The five inoculated remained healthy, while two out of the five uninoculated got plague and died. In hut 18 of the same ward three inoculated persons remained healthy, two uninoculated died out of a family of five. In hut 26, also in ward 4, one inoculated person escaped, two uninoculated died out of a family of three. In hut 8, ward 1, four inoculated persons escaped, while the one who remained uninoculated contracted the disease and died. In hut 24, ward 2, out of a family of two, the inoculated member escaped, the uninoculated died. In hut 20, ward 3, one of the three inoculated contracted plague but recovered, while one of four uninoculated got it and died. In two out of the three huts where fatal cases occurred among the inoculated, a death also occurred among the uninoculated, and in only one instance in the whole did a case occur among the inoculated, while the uninoculated went free. This was in hut 31, ward 4, where one of four inoculated contracted and died of plague, while two uninoculated escaped. These figures have been verified by Surgeon-Major Bannerman, Madras Medical Service, Surgeon-Captain Dyson, Bombay Medical Service, M. Haffkine and myself, case by case and family by family, and seem to me to prove that while inoculation as at present practised is not an absolute protective either against seizure or death, it is of immense value both as a prophylactic and as modifying the severity of the disease and reducing the case mortality. This was 37·5 per cent. among the inoculated, against 92·85 in the uninoculated."

The next instance where inoculations were applied under conditions permitting of a comparison between the inoculated and the uninoculated, was that of the Khoja Musalman community of Bombay. I shall quote only a summary of the results, the detailed figures and the manner in which it was possible to arrive at them having been given in a printed Report.† Altogether the community numbered over 13,000 people, and of these 5,184 were inoculated, whilst 8,146 remained uninoculated. Taking the numerical strength day by day the average of inoculated was 3,814 and of the uninoculated 9,516. Amongst the uninoculated there were 177 deaths from all causes. The inoculated group comprised persons of all ages including a considerable number of babies in arms and old people above 61, but the proportion of these extremes of ages was lower amongst the inoculated than amongst the uninoculated. In order to eliminate the possibility of a mistake arising from this I have excluded from the comparison all cases of deaths in the uninoculated amongst children below 3 and old people above 61, although the figure 9,516 uninoculated includes the children and the old people. The number of such deaths was 59, whereas 118 deaths occurred in the rest of the uninoculated community. Amongst the inoculated there were altogether 7 deaths. I was able to ascertain that of these 4 were due to other causes than plague, and 3 to plague. But I do not know for certain how many of the 118 deaths that occurred in the uninoculated were cases of plague and how many were cases of other diseases. Only approximate calculation was possible by taking into account the ordinary mortality in the Khoja community during the years previous to the advent of plague. The mortality, however, varied so as to somewhat invalidate the importance of the average calculated upon it. In 1892 the community had 131 deaths, in 1893, 96, in 1894, 100, in 1895, 106, and in 1896, 96 deaths, giving an average of 105 deaths during the period of the year corresponding with the period under

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*See Appendix No. III in this Volume.

† See Appendix No. IV in this Volume.

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observation,—between 27th December and 20th April in each of these years. If this number of 105 deaths be taken as indicative of what should be the number of deaths from general causes in the year of plague, 9,516 uninoculated should have had 77 deaths from plague and 94 from other causes. Amongst the uninoculated who died from plague, there was one baby below three years, and four people above 60 years, giving a total of five deaths; amongst those who died of other causes than plague, there were 33 deaths in babies and 23 in people over 60 years, giving a total of 61 deaths. If these deaths are excluded, the 9,516 uninoculated had 72 deaths from plague and 38 deaths from other causes; whereas 3,814 inoculated had three deaths from plague and four from other causes. This represents a difference of 89·7 per cent. in deaths from plague in favour of the inoculated part of the community, and of 73·3 per cent. in deaths from other causes in favour of the same part of the community. I believe that in calculating as above I have avoided overstating the case, but the investigation could not be pushed to anything like the precision which was possible in other more circumscribed communities.

70. (*The President.*)—I do not know whether you have any more instances; if you have, will you give us results?—I will give as another instance the results of the operations performed at Hubli, in the Southern Mahratta country, where a larger proportion of the inhabitants has been inoculated than in any of the other place. The inoculations at Hubli were performed by officers not connected with the laboratory, and the results I will quote come from the reports forwarded by the Collector of Dharwar to the Government of Bombay. The first report at my disposal refers to the week ending 26th August 1898. At that time there were 3,815 uninoculated at Hubli, who in the course of that week had 446 attacks of plague, while 9,257 inoculated once had 31 attacks, and 26,428 twice inoculated had 35 attacks. The percentage of protection, calculated in the same manner as in other cases, represents a reduction in the number of attacks of 97·1 in those inoculated once, and of 98·9 per cent. in those inoculated twice. The number of failures amongst those who had undergone only one inoculation was, therefore, 2·9 per cent., and amongst those who had undergone two inoculations 1·1 per cent., that is to say, the second inoculation appears to have further diminished the incidence of plague in the inoculated 2·6 times. During the second week ending 16th September there were 1,016 uninoculated, who had 153 attacks, 6,481 inoculated once, who had 16 attacks, and 30,911 twice inoculated, who had 39 attacks. The reduction in the number of attacks amongst the inoculated once was 98·4 per cent., and among the inoculated twice 99·2 per cent.; so that the number of failures amongst those who were inoculated once was 1·6 per cent., and among those inoculated twice 0·8 per cent. In this instance the second inoculation appears to have further reduced the incidence of plague among the inoculated by one-half.

71. (*Prof. Wright.*)—In the first case you had failures of 1·6 per cent. Did many of those plague cases occur within the first day or two after inoculation? I want to learn whether your second inoculation added anything to the protection which was conferred by your first inoculation?—I have not been informed as to whether the cases you mention have been excluded.

72. Because your figures as they stand do not prove that you gained anything by your second inoculation?—Yes, it is so. I regret there is no information about that in the reports before me. The last of these reports refers to the week when the cases of plague being greatly reduced the refugees who had deserted the town began to come in, and increased the number of the uninoculated A certain number of cases having occurred among these new arrivals it was impossible to calculate precisely the reduction in the number of cases, and the percentage of failures. With the data placed before you, I believe, the original programme put to me for my evidence has been completed. I do not know whether I should give you before I finish the additional explanation that you have asked for. It referred to the dosage of the prophylactic. I have stated that the maximum dose which we have adopted finally was two-and-a-half c. c.; this refers to the strongest material that we ever had. We call the dose of two-and-a-half c. c. the standard dose; we could never produce a material which, when injected in smaller quantities than this, would produce an amount of fever which we have agreed conventionally to consider as an indication of a sufficient reaction and of a sufficient protection conferred on the inoculated. The indication which we adopted consists in a rise of temperature, reaching 102° F. on the average. It is, however, only in exceptional instances that we have a material of the standard strength. The plague prophylactic is prepared by a biological process regulated by more complicated laws than those of purely chemical processes. The influences which the microbe undergoes in the course of the preparation are, in many instances, beyond our control. In order to make this statement perfectly familiar, it is sufficient to refer to the practice of the fermentation of alcohol. Everyone knows to what extent the result of brewing varies in accordance with conditions, the majority of which escape the knowledge of the brewer and of the chemist. We must be prepared from the beginning for the fact that we shall turn out a material varying in its quality, and if we were to fix the average dose at which the material should be used we must expect a variation in the result. If on the other hand we want to have the result fixed we must vary the dose. The variation referred to depends, among other things, on the following observable circumstances. First among them are the properties of the living organisms which we use for our fermentation. In the same manner as the brewer is most anxious to get a particular kind of yeast for his operation, we require a proper microbe for the plague prophylactic. In this instance the virulence of the microbe is the essential characteristic. Secondly, the artificial medium, which we prepare for fermentation, cannot be made in such a manner that it should represent perfectly fixed qualities. The same microbe being inseminated in different fluids, prepared on different occasions, or prepared with a material which slightly varies, gives different results. The amount of growth obtained varies, and the amount of secretions, and the degree to which the liquid is modified by the microbe, varies also. In accordance with these results we vary the dose. If the amount of fever produced by the injections is not sufficient, the dose is increased. The multiplication of the dose which we admit does not go, as a rule, beyond 10 c. c., that is, we do not use, as a rule, the material which when injected at the rate of 10 c.c. fails to produce the necessary amount of reaction. But, up to lately, we could not afford rejecting any brand which on being used in that dose gave the requisite reaction. In operations at Kirki or in the different series of inoculations performed in Daman. the material used varied in strength and produced different degrees of fever, and the dose at which it was injected varied. A direct connection between the results and these details of the operations were observed there. Those inoculated with weaker material which produced a smaller amount of reaction showed afterwards a higher mortality, and people who were inoculated with a larger dose gave a lower mortality. In Kirki, for the first time, I raised the dose up to 10 c. c. Between the inoculations done in Bombay and the inoculations in Kirki, our material got markedly weakened. In Lanauli we increased the dose from two-and-a-half c. c. up to six-and-a-half c. c. and in Kirki, as stated, up to 10 c. c., and it was registered that even that amount did not produce very marked fever. It was, however, the result of the inoculations in Kirki which encouraged me more than any others, because they were carried out with a material which was the least promising of any that we have used.

73. (*The President.*)—I think that is as full an explanation as we require?—I hope, Mr. President, that you have approved of my having avoided in the course of my evidence the discussing of the method from a theoretical point of view. I have only to request that in the questions which may be put to me to-morrow that line of enquiry may, as much as possible. be followed. I should like to exclude from the proceedings any discussion of a point of view which does not pertain entirely to facts and to the results obtained.

74. (*The President.*)—Your wishes shall have every consideration, but I cannot give you any indication of the line upon which questions will be based. It is for you to object at the time the question is put.

(Witness withdrew.)

(Adjourned to to-morrow.)

At The Secretariat, Bombay.

SECOND DAY.

Wednesday, 30th November 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.
MR. C. J. HALLIFAX (*Secretary.*)

M. W. M. HAFFKINE, recalled and further examined.

M. W. M. Haffkine.

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75. (*The President.*)—Yesterday you gave us a great many very interesting examples of vaccination at different places, the results of which were favourable, but can you tell me if they are average examples or if you have had results which fell lower in apparent good than those which you have already stated?—I have enumerated *all* the instances where the method was put to an experimental test by me and my officers personally, and applied under conditions permitting of an accurate comparison between inoculated and uninoculated. Their result was stated yesterday, none of the experiments being omitted. The case where the results fell the lowest in the good observed was that in Kirki. Since then attempts have been begun to introduce the inoculations as a practical measure for combating the epidemic in the stricken districts. Of these attempts I quoted only one, the most notable, that made at Hubli. The result there was satisfactory. Apart from that instance, two reports only reached me of similar attempts, on a scale far smaller, where the results were not so good. One of these refers to Billimora in the Baroda territory and another to Bulsar. In Bulsar the inoculations were applied to the whole population of the infected area, a very small proportion of people having remained uninoculated, with the object of seeing to what extent plague could be arrested by that. The number of cases was rather considerable: I do not remember just now the exact number. The case mortality, however, was decidedly favourable. They stated that when an inoculated person was admitted to the hospital, they could say at once that that person had been inoculated, the type of the disease being markedly milder, the look of the patient different. As far as I remember, the mortality was something like 25 or 30 in a 100, instead of the usual 60 to 80 per cent. From Billimora they sent a number of cases, stating in their report that these were the instances of failure; there was no information as to the parallel occurrences in uninoculated persons, as this, apparently, was not the object of the report. These are the only two reports I have received up to the present of the attempts in question, in addition to the preliminary data from Hubli.

76. You have not found much difficulty in getting the people to be inoculated, have you?—This depends on the manner in which the inoculations are introduced. Personally, I had never any difficulty, and I may, in an anecdotal manner, quote instances where against all expectations we succeeded in introducing inoculation in the easiest possible way. When I heard that plague began to increase and take a severe form in Lanauli, I immediately addressed the Surgeon-General with the Government of Bombay, asking him to kindly inform the medical officer in charge of the place about my intending to go and introduce the inoculations there. I did not receive a reply for several days, and when the reply came it was to the following effect. Apparently the Surgeon-General did not conceive exactly the meaning of my request, and in order to spare me the trouble of going for nothing, asked the medical officer in charge to find out whether it was possible to introduce the inoculations into Lanauli. For complying with this request that officer required a few days. He then wrote and stated that he had collected the representatives of the community together, and there were only one, or perhaps two, among them who were willing to undergo inoculation. He said that the large majority in the place were decidedly against inoculation, and that the plan would be impossible. When I received this reply I without delay went to Lanauli and proceeded in the following manner. I collected in the Municipal office the same representatives who had stated that the vast majority of the population were against inoculation, and I asked who were the one or two individuals who agreed to be inoculated. They came forward and were inoculated at once in front of the others. Then, I believe a servant in the Municipal office declared that he also wanted to be inoculated, and was done on the spot. If I am not mistaken, he was followed by a retired Subadar-Major, then by the Municipal Secretary, and so on. In all 35 persons were inoculated on that first day. I believe on the next day one of the persons inoculated said that a few of his servants wished to be inoculated. Others were observing carefully the persons operated upon, and when they saw that after 15 or 24 hours the men appeared cheerful, still with painful places on their arms, but in the best of spirits, more came forward, and so on. Within one week the number of inoculated was above a half the total.

77. You told us yesterday you had varied the doses according to the effects of the first inoculation, and then gave examples; did you not find that an inconvenience, because I suppose it would necessitate a subsequent inoculation when the dose was found below that which produces the desired result?—Not in the least. First of all I must state that the desirable method would be to do two inoculations in every person, and this for the following reason. When you have before you, say, ten persons to operate upon, and you use one and the same brand, or bottle, of prophylactic, the same syringe, and the persons in question are, say, soldiers, that is to say, people in an average good state of health, of an age and constitution varying very little, you will invariably find considerable variations in the results, everything else being equal, the individual only varying. Not infrequently you will find on injecting a given dose in two individuals that one will produce 99 or 100 degrees of fever and the other 103 or 104. If you employ a given material and one fixed dose, you have to be prepared for considerable variations in the reaction according to the individual properties of the persons inoculated. The ideal method is that every person should undergo a first inoculation with a tentative dose in order to see how he will react; and then, from the result of the first inoculation the second and the final dose should be decided upon. This is the method we tried to introduce wherever it is possible.

78. Do you place much importance on the mere fact of the reaction apart from the quantity?—Yes, up to the present my information, which is, however, not based on isolated individuals, is to the above effect. Being guided by the reaction, as I said yesterday, we attempted to produce on an average 102° of fever. That proved to be the most precise method, as to results obtained, which I am aware of for dosing. From the information which I put before you yesterday, you will have noticed how little, relatively, the final result of inoculation varied in our hands. One can say in a general manner that the reduction in the mortality produced by inoculation is between 80 and 90 per cent. The possibility of making such a statement is so unexpected that you will find up to now a number of persons who will meet our publications with incredulity because of that. There is a series of other advantages with the method I mention. We have not to undertake special experiments in order to determine the

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power of our material. The information necessary for guiding the officer is obtained in the course of his day's work. Not only is this a very important consideration for us. The material has to be sent out to far-away places, where it is not always used immediately, but sometimes kept for weeks and months. In a country where the average temperature is so high as in India, there is the possibility of the prophylactic getting gradually deteriorated. It is of great advantage that the operator should have an easy method of ascertaining for himself whether the material is not deteriorated, and whether he has not to change the dose to be used. The present instructions are that when he begins a new series of inoculations, he should watch his first 10 or 20 patients, and, judging by the reaction produced, either stick to the dose prescribed on the bottle, or take it upon himself to increase the dose if necessary. The operator does this without a laboratory, special experiments, or any technical instruction. And lastly, by the plan now adopted, the number of operations performed upon animals is reduced to the least possible extent.

79. Have you any definite reason to suppose that your substance is not purely therapeutic as well as preventive or prophylactic?—No, sir, I have not subjected this question to any accurate examination; but the general impression which I have had up to now is that it is not likely to influence the course of the disease when the symptoms have already started.

80. (*Mr. Hewett.*)—I understand that the experiments with your prophylactic have taken place outside the Bombay Presidency?—Not in the shape of experiments, but a considerable number of inoculations have been done in various places. I expect you would include Baroda in the Bombay Presidency.

81. I include Baroda. Was the prophylactic used at Calcutta?—Not in the shape of experiments.

82. It has been utilised there?—Yes.

83. But details are not available?—No.

84. At Belgaum, were there experiments conducted by Major Bannerman?—There was a considerable number of inoculations done there.

85. Did he not keep records?—Oh, yes. Records in the form of an accurate description of every inoculated person would certainly be kept; but I do not know whether any comparative observations have been collected as to the cases which have occurred after the introduction of inoculation.

86. Major Bannerman was working with you on this prophylactic for some time, and he went from Bombay to Belgaum to carry out inoculations just as you have carried them out at Daman; has he not kept similar records?—Not a record of the results.

87. Why is that?—He did not go with that object. He went to start inoculation in a plague-stricken locality.

88. With reference to the readiness of the people to submit to inoculation, I suppose it is more difficult to get them inoculated when there is no plague about than when the plague outbreak is in full swing?—Yes, it is undoubtedly so with this measure, as with many others.

89. In one of the reports you made to the Government of India, I think as regards Daman, you said the question of the duration of the protection had not been established. Have you any further facts as regards that?—No, except very general information. This question is going to be submitted to an accurate investigation. We have now several communities where the inoculations were applied, in the first outbreak or during the second outbreak, and in which only a small number of inoculations has been done since. These communities are going to be investigated if we have another rise of the epidemic during this cold weather, or even without that.

90. Then you anticipate that you will be able to place the evidence before the Commission on this point before it concludes its sittings?—Yes, I hope I will. In the case of the Khoja community in Bombay, the Director-General of the Indian Medical Service, Surgeon-General Harvey, was kind enough to promise that in the month of March, or if possible before that, he would come to Bombay and investigate with me the occurrences of plague amongst the Khojas if there is a marked recrudescence of plague in the city during this cold weather. A large number of Khojas was inoculated at the beginning of this year, as I stated, yesterday. We watched the occurrences of plague amongst the inoculated since then, and the number was exceedingly small. The Khojas were informed that at present there was no indication of the necessity for inoculated persons to be inoculated again, and that they would be given notice immediately when any such indications appear.

91. You have the materials upon which you could make the same kind of comparison later on?—Yes.

92. Have you made any experiments as to the communication of plague by animals to human beings?—No.

93. When you were at Hardwar, did you not find monkeys infected by plague?—Yes. It is possible that a small number of monkeys, about half a dozen, were affected by plague at Hardwar, but I did not observe them. The monkeys which I had the opportunity of seeing during my stay there had no plague. Among the monkeys which died before my arrival, there were five or six from which I could not get living specimens of microbes, but microscopic specimens from them had been made by the officers on plague duty, and the appearance of bacilli in those was compatible with the form of plague microbes.

94. You have not investigated the question as to how far an outbreak of plague among human beings is preceded by the occurrence of plague among rats?—I have not investigated that accurately. A large amount of information in Bombay was received of houses where dead rats were found just before cases of plague occurred. I know personally of several instances where dead rats were found, the authorities given notice immediately, the houses carefully disinfected, and then only cases of plague in man followed. This sequel of facts points to the absolute authenticity of the information that dead rats were found before the occurrence of plague in human beings.

95. Can you speak to that of your own knowledge?—Not from any further experience than the above.

96. Have you made any experiments as to how the soil gets infected during the course of the epidemic of plague?—We are carrying on experiments to that effect at present.

97. Have you an officer employed under your directions in these experiments?—Yes.

98. What is his name?—Dr. Maitland Gibson.

99. (*Dr. Ruffer.*)—I should like to have a little information on some technical matters which interest me and will interest the Commission from a bacteriological point of view. I noticed yesterday in your evidence that you told us you cultivated the plague microbe for a period varying from four to six weeks. But you did not tell us at what temperature you cultivated it?—Between 80° and 90° Fahr.

100. It does not matter to a degree or two?—No.

101. Then I gather from the evidence that you gave us that the culture, or at least the prophylactic fluid you injected, was sterile fluid?—Yes.

102. I do not think you mentioned exactly how you sterilized the culture?—The method adopted to sterilize the culture is two-fold. First, the liquid is subjected to a temperature of 65° C. for an hour. I have found from an exact experiment that it is possible to kill the plague microbe with a temperature of 45° C., and that no very prolonged heating is required for that. I have adopted 65° C. for giving a margin for mistakes from an unexpected fall of temperature. Similarly, I have adopted one hour as the period during which the cultures are heated, although it is certain that the microbe of plague does not require anything like that time for being killed.

103. What is the quantity of culture you sterilized each time?—As a rule, between a litre and a half and 2 litres in each flask.

104. The thermometer is placed in the culture itself?—The observation as to temperature is made in the following manner. The flasks are heated in a big water tub. I am not able to tell you the number of gallons which the tub contains; it is, I should say, a 100 times larger than the contents of a flask. Five or six flasks are put simultaneously into such a tub. We begin by heating the water to 70 degrees; when the flasks are introduced, there is a fall in the temperature. A control flask is put in the middle between the other flasks. This flask is of the same shape as the others and contains a quantity of liquid equal to the quantity contained in the other flasks. Into this control flask a thermometer is placed. The hour of heating begins to count only from the moment when the thermomete placed in the control flask shows 65°C. After the flasks have been heated, carbolic acid in the proportion of one half per cent. is introduced into them.

105. That is ·5 per cent?—Yes. I have ascertained that ½ per cent. of carbolic acid is sufficient to kill the plague bacilli within a comparatively short time. A very elaborate procedure is adopted, which I shall be glad to put at the

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disposal of the Commission, to insure that on no occasion does a flask, which has not been heated or has not been carbolized, pass into the hands of the decanters.

106. Will you tell us the procedure?—Certainly. I will send you a copy of the rules.*

107. I suppose you ascertain again that the prophylactic fluid is sterilized?—No. We do not make any further tests at present. On many occasions it has been done.

108. But as a matter of routine you do not ascertain it each time?—No; though with the extension of the operations I intend to revert to that practice.

109. You said something about the effect of temperature; can you tell us whether the heating to 65° alters the prophylactic fluid in any way?—I have not made any comparative experiments on this point. But having in mind the fact that microbes and their products generally are influenced by heating, I tried to avoid superfluous heating as much as possible.

110. In your evidence yesterday you said a large number of people had been inoculated twice; it would be very interesting to know whether the local and general reactions of second inoculation are as marked as in the first inoculation?—In a number of cases it has been reported that it is so, but I do not know whether the number of cases is sufficiently large to accept such a result as a rule. It is difficult to subject the question to an accurate investigation. I have the impression that there is a difference in this respect between a second inoculation done 8 or 10 days after the first, as a part of the same treatment, and a second inoculation which is performed some six months later, on the occurrence of another epidemic. It seems as if persons who are re-inoculated at a long interval suffer less than when they were inoculated for the first time, while I am not prepared to support that for the second inoculation which is made 8 or 10 days after the first.

111. (*The President.*)—Do you mean they suffer less locally?—Yes, locally.

112. (*Dr. Ruffer.*)—Is there a marked effect on the temperature?—I do not know exactly.

113. You have no facts which you would like to publish with regard to that?—No.

114. It is still under observation?—I have, in the records supplied by the inoculated as to their symptoms, a large number of data referring to this question, but I have never subjected it to inquiry, chiefly because the information supplied by the patients is on the average not accurate enough to warrant conclusions.

115. Have you ever made experiments on animals as to whether the second inoculation reinforces immunity or not?—Permit me to complete my answer to the first question by the following information. I have treated big animals by repeated injections with increased quantities of plague virus. I have all the data and the charts in my laboratory, but the general result is as follows:—I had animals which in the beginning, being inoculated with some 5 or 10 c.c. of either dead or living cultures, would give a high rise of temperature extending over 6 or 7 degrees above the normal. These animals in the course of several months or a year, could be brought to such a state that they could be safely inoculated with a litre or a litre and a half instead of 5 c.c. The general result was that the animals became less and less susceptible to the material. As to the local effect, I have ascertained the following result. If you take a fresh animal, a horse, goat, or a sheep, and inject it at once with a large quantity of microbes, for instance, 20 c.c. instead of 5 c.c., you would produce local mortification of the tissue, and the place injected, after having swollen up, will slough off. Whereas, by repeated inoculations with gradually increased doses, it is possible with impunity to increase a dose up to 50 or 60 times the initial without producing any such effect. That immunity, however, would extend only to the particular part of the body where the injection is repeatedly done. If a horse is treated by injections under the skin of the neck, you will reach in the course of time a condition where injections with large quantities will fail to produce the sloughing in the neck, but will cause such on the shoulder or flank.

116. It produces local immunity?—Yes, precisely. In the case of a man, the preparation cannot be made gradually, because the number of inoculations cannot be repeated so frequently. When it is done, however, the tendency must be to prepare an immunity for the local swelling as well as for the rise of temperature.

117. So that an animal reacts differently to a first and subsequent inoculation?—Yes, to a first, say, and a tenth, for instance.

118. The prophylactic that you used is sometimes kept for several days or months?—Yes.

119. Have you any facts to show whether it is altered by heat or by exposure for a long time to air? Have you any reason to believe that it alters in the course of time?—I have not made accurate comparisons, but the material which I used at Kirki, and described yesterday as having produced a reduction of mortality by 77·9 per cent., had been kept for several months in the hot season in Bombay. It is possible that it was partially the heat that was responsible for that material having lost some of its power to produce fever.

120. You do not think carbolic acid alters it in any way?—I have not made any accurate experiments on this point.

121. Or exposure to air?—It is little exposed to the air.

122. I thought, perhaps, you might have experimented upon that?—No.

123. There is another question which does not arise out of the evidence which you have given before us, but which may perhaps interest us, and that is the question of the evacuation of the plague bacillus by plague patients. Does the bacillus of plague pass in the urine or in the fæces of man?—I have not made any inquiries myself, as some other Scientific Commissions in Bombay did that. One of my assistants made a short series of experiments on urine, but I do not think he has discovered the plague bacilli there.

124. What is his name?—Dr. Surveyor.

125. You have said you have no evidence as to the contamination of houses by rats and other animals: have you any evidence as to the possibility of inoculation of people by fleas or other parasitic blood-sucking animals? A dead rat very soon gets covered with fleas. In your opinion, might the bite of such a flea inoculate a person with plague?—I have not made any observations personally in regard to that. That conclusion appeared to me very plausible from the first observations I made here in Bombay as to the general propagation of the disease; and I suggested that a series of experiments be made in that direction, but I could not do them myself. As a member of the Plague Research Committee, Mr. Hankin made experiments in that direction, and collected a certain number of facts.

126. In the people you have inoculated with your prophylactic, have you noticed any change in their blood or in their tissues; have you noticed, for instance, that the blood of a person who has been inoculated with your prophylactic fluid has an immunising effect or curative effect on another person or on an animal, or any action on the bacillus itself?—Observations in that direction have been made by the German and the Russian Scientific Commissions.

127. But you yourself have made no observations?—No, I left it to them. I furnished them with patients, and collected for them specimens of blood, but left the examination to them.

128. On the immunising properties?—I do not think it has ever been tried with the blood of men.

129. You have just said that you inoculated a number of horses with plague and produced certain effects. Can you inform the Commission whether the serum of the horse had any curative or immunising or agglutinating effect on the plague bacillus?—As to the agglutinative effect, the German Commission made a series of experiments, and they found there was a great difference between different animals in that respect.

130. Is that your evidence, or the evidence of the German Commission?—It is the result of the observations of the German Commission. As to the curative effect, I made personally a large number of attempts to treat plague patients with the serum of animals immunised against plague, but only on one occasion had I the impression that that treatment influenced favourably the course of the disease.

131. (*The President.*)—What is the thing which you injected?—It was the serum of large animals, of horses, goats or sheep. In each particular case I have the data as to the origin of the serum; it was taken from animals at different stages of their being treated with increased quantities of plague microbes.

132. Can you tell the Commission what was the ultimate dose before the withdrawal of blood?—The ultimate dose

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* See Appendix No. V in this Volume.

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which an animal received before the serum was taken for treatment varied; as stated, I tried the property of the serum at different stages of treatment. The general programme was to give the animal gradually increased quantities of plague virus, so that if I tried the animal after one month of treatment the last dose with which it had been treated was a small one; but when I tried that animal after 10 months, it had undergone a larger number of injections, and the latest dose was much more considerable. In every case and with regard to every animal I have the exact data as to the whole course of the treatment it had undergone before its serum was taken for that case.

133. We will have that put in.* Taking this case in which the immunisation or protection of the horse was carried to the highest point before the serum which you used was drawn, what was that dose relatively to the minimum lethal for that animal?—I have not tried to prepare a curative serum from an animal which was susceptible to plague; so most probably neither of these animals would have succumbed to an acute disease when injected even with a large quantity of plague microbe. The animals which seemed to suffer most were the goats, but even they did not succumb to an acute attack. All the goats which I treated with increased quantities of plague virus gradually wasted away and died in two, four, eight months. Some of the animals I utilised for curative treatment had been treated for about a whole year, and received as the last injections some 1,600 c.c. simultaneously. As I mentioned, only on one occasion in a small group of six patients had I an impression that the curative treatment produced a favourable effect upon the course of the disease. This was during the outbreak of plague in the Byculla House of Correction which I mentioned yesterday. Apart from the application of protective inoculation in that gaol, I took over also a tentative treatment in a few of the patients who were admitted to the Plague Hospital. I acted in the following manner. On the date of inoculation (as I mentioned yesterday) there were among the non-inoculated six patients admitted. I asked the medical officer in charge of the jail hospital to tell me which of the six patients, according to his personal experience, were in a more serious condition—were the least promising,—and he pointed out the patients in the order in which he understood them to be in that condition. I selected for treatment by this specific the three who were in a more critical state. Then on the next day, I believe there were two patients admitted; I adopted the same course, and out of the two patients took for the serum treatment the one who appeared to be the least promising. In the course of the outbreak in the jail I had six patients under treatment which were compared with six not treated, admitted with them on the same dates. Out of the six treated patients, three only succumbed and three recovered; whereas out of the six non-treated, I believe, five succumbed. The three who succumbed amongst the treated lived longer than the untreated. This is the only instance where I had encouraging results from my treatment. If you care to have the exact information, I can give it to you.

134. I think it would be interesting if we can get the exact number of patients and the clinical data, and the description of the serum which you used: have you tested the serum against the lethal dose in animals?—On many occasions I found the serum exceedingly efficacious when tried on animals. I have the exact data.

135. Before, after, or simultaneously?—As far as I remember, I think the serum in insignificant doses arrested the disease in animals 24 hours after they were inoculated with the lethal dose, but I can give the exact information from the laboratory books.

136. (*Dr. Ruffer.*)—Will you kindly give us the exact information as to the strength of the serum which you used in each patient, and as to the exact results, and as to the way in which you did the experiments?—That would require a prolonged enquiry into the records, and I would propose that a member of the Commission should come to my laboratory, where I will put at his disposal my books.

137. (*The President.*)—It is a question merely of collating information which you already possess, not making further investigations?—Yes.

138. I do not think it is necessary for a member of the Commission to do this?—In that case, I am sorry I will only be able to give the final conclusion, as I never had time to put the materials in order, in the shape of a report.

139. (*Dr. Ruffer.*)—But perhaps later on, in six weeks or two months' time, when we come back, you will give them to us?—I will attempt to do that.

140. Can you give the exact data?—This was the general result. To complete the statement on cases treated in the Byculla Jail, I must state that altogether in jail there were 34 patients admitted and 17 died—a mortality of 50 per cent.; and out of those only six were treated, three of whom died. And although the treated patients seemed to have been in a worse condition, I would not be justified in drawing conclusions from my result. But I have subjected my serum subsequently to a far more complete test, and it is because of that and because I had no more time to devote to an attempt which did not appear promising in my hands, that I have suspended any further efforts in that direction. At first, while I had only a small quantity of serum at my disposal, I attempted to find out its curative power by the following method. I visited the Arthur Road Hospital, which had the largest number of plague patients in Bombay, and left it to the Medical Officer in charge to point me out those cases which in his opinion were hopeless; that is, those which, he thought, could not recover without the assistance of some new, additional treatment. He told me, for instance, at once that he had a patient who had the day before a temperature of 107°, and that up to that time not a single patient had passed through the hospital who recovered after having had that temperature. In the same manner he pointed me out a certain number of other patients who, in his opinion, had no chance of recovery under the ordinary treatment. I reasoned that if a proportion of such patients recovered under the specific treatment, I would have an indication that the serum treatment produced a greater effect than the ordinary treatment adopted in the hospital. Very soon I had to abandon that method, as no such indication was obtained. A curative treatment which has not the power of helping in critical cases might, however, still prove useful. When the medical officer has before him, say, 100 patients, there are, of course, amongst them three different categories: one which will for certain recover, another which will for certain succumb, and a third category in whose case the balance, by a useful treatment, may perhaps be turned in favour of recovery. The serum, even when powerless with regard to the second category, would prove exceedingly useful if it were to assist with regard to that intermediate group of patients. I suspended temporarily further attempts until I had accumulated a sufficiently large amount of serum, and went to Poona when the plague epidemic was on the increase there, at the time when the number of patients admitted in the Poona General Plague Hospital was between 20 and 30 per day. The observations were made by Major Bannerman, who was at that time attached to my laboratory, and by myself. We visited the hospital daily, from the early morning, and took the name of every new patient admitted. With the exception of those who died within an hour or a few hours, that is before we could see them, we treated with plague-anti-toxic serum every second patient admitted during the hours we were at the hospital, irrespective of the information as to the serious or promising condition of the patient or the duration of the disease before admission. Without selecting patients according to our personal impressions or to the statements supplied by the medical officer or by the patient or his relatives, we subjected to the treatment every second arrival. After a couple of hundred patients had passed through our hands, we compared the mortality statistics among the treated and among the non-treated. I expect it was an accident, but the mortality amongst the treated was higher than amongst the untreated. The moment that became clear, we suspended further treatment.

141. (*The President.*)—What are the numbers?—They were within 200. That is to say, about 100 of them were treated and 100 were not treated. I consider this the only reliable method for finally testing a curative treatment. We suspended the treatment in Poona where we had injected considerable doses of the serum. Further attempts were made in Bombay, but exceedingly cautiously, with some homœopathic doses,—injecting 1 to 5 c. c. of the serum, or so. In the attempts made there by the French, Russian and, if I am not mistaken, also by the Italian Commission, 200 and 300 c.c. of serum were occasionally tried. We varied the treatment in many ways. For instance, a patient would receive only 1 c.c.; or he would receive that amount repeated every five hours; or again he would receive a dose of 10 c.c. once in two days. The patients were always observed comparatively with others admitted at the same time. In no case did we observe a noticeable advantage on the side of the patients treated.

142. Have the results of other Commissions been published?—I do not believe they have been published fully; but some preliminary results were given. For instance, Dr. Yersin, from Paris, published briefly his observations

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* See the record of this witness' re-examination of the 22nd March 1899.

made in Bombay; and I believe the Italian physicians now working on behalf of the Municipality here have published their observations collected in the Arthur Road Hospital.

143. (*Dr. Ruffer.*)—Have you any experiments as to immunising persons with serum from an immunised animal?—No.

144. You do not believe that it would have any advantage over the prophylactic fluid which you used?—Theoretically I am prepared to expect it will have one particular advantage. As I stated yesterday, I believe the present material used for preventive inoculation has an exceedingly rapid effect, and acts in from 12 to 24 hours. We do not hesitate to inoculate persons who had been notoriously exposed to infection: they are inoculated as early as possible. The only persons whom we abstain from inoculating are those already showing symptoms of the disease. But a serum from animals immunised beforehand may have a more rapid effect. I have not, however, subjected this to a trial.

145. Do you think one could immunise persons quickly with serum, say, immediately, and then apply the prophylactic afterwards?—Yes. In the inoculations against cholera I have since a long time devised the plan of injecting simultaneously the cholera vaccine, diluted in such a serum.

146. You think that might possibly be tried with advantage?—Yes. Theoretically it is a sound plan.

147. You do not think that possibly the action of the immunising serum might neutralise the action of the prophylactic fluid?—I had to contemplate that, but the question is to be solved by a trial.

148. You have no evidence bearing upon that point?—No.

149. Mr. Hewett asked you about monkeys, and you have told us also about rats: have you any evidence showing that plague may appear amongst other animals? We have read, for instance, in Dr. Yersin's paper with regard to the plague in Hong-Kong that plague bacilli were found in flies: have you any evidence of plague appearing in birds, kites, crows, or vultures, or evidence of its appearing in cattle? It is rather a practical point because the importation of hides coming from India is prohibited in certain countries on the supposition that they may transmit plague?—Vultures were particularly interesting objects of investigation because of their feeding upon plague patients, the bodies of Parsees who had succumbed to the plague. Mr. Hankin tested their products.

150. You have no experience of your own?—No.

151. You have no experiments referring to flies?—No Some experiments have been made in Hong-Kong by Dr. Yersin; while in Formosa Japanese investigators are stated to have discovered plague microbes in fleas. I have no personal information to give upon that, except to point out that it is exceedingly important to know how the investigators, who have detected plague microbes outside a plague patient or a plague rat, identified the plague microbes, because it is certain there existed no sure way of diagnosing the microbes, except by the fact of their coming from a person who was notoriously a plague patient, or from rats dying in plague localities. When Dr. Yersin, who described also plague microbes found in soil and floors, was in Bombay, I particularly enquired in what way he diagnosed those microbes; and I am not certain whether he was absolutely sure to have dealt with fully authenticated plague microbes. In every instance where statements to that effect are made, it is essential to find out in what way the medical officer diagnosed those plague microbes.

152. Have you any facts bearing upon the question of plague occurring in cattle?—No, I have none, except the experiments I mentioned above upon the artificial inoculation of large animals with the plague virus.

153. Could you give us any evidence as to the life of a plague microbe outside the human body; for instance in soil, food-stuffs, or milk, or especially water?—I have not made personally experiments with regard to that, but the German Commission and Mr. Hankin have investigated the fate of the plague microbes when introduced artificially into different media, into water, food-stuffs, and so on. Experiments are being carried on in my laboratory with the object of detecting plague microbes in the surroundings of plague patients, and in plague houses. These experiments have been multiplied lately. We are working with a method which seems to me to be an exceedingly sensitive one for the purpose. The investigation refers to articles containing, under the ordinary conditions, infinite quantities and varieties of microbes. We test these samples always in a double form. A gramme of soil, for instance, or of floor scraping, is mixed with a small quantity, say 4 c.c., of tap-water; the mixture is put in a test tube, well shaken, and then divided into two parts: one is left as it is, and the other is contaminated with an almost immeasurable trace of plague virus. The latter procedure may be done for instance like this: one takes an agar culture of plague bacilli, and scrapes the growth off the surface; after that the tube is rinsed twice or three times with pure tap-water, till all traces of growth are washed out of it. Into such a cleansed, but not sterilized, tube half of the sample to be tested is introduced and immediately poured out again. The admixture of plague microbes thus effected is so small that it is very rare that cultivation reveals their presence at all. Both parts of the sample, the one left as it was and the other contaminated, are then injected into rats. The effect of the contaminated sample is that the rat almost invariably dies in from 36 to 48 hours, and in the vast majority of cases we detect a pure culture of plague-microbes in the organs. Rats have, therefore, an exceedingly selective power with regard to plague bacillus. Out of 20 rats inoculated in this manner, 15 or 18 will die, and a pure plague cultivation will be discovered say, in 14 or 16 of them. While this is the case with the rats injected with the contaminated samples, it is very exceptional that the rat inoculated with the sample not contaminated artificially succumbs; and in no instance have we discovered plague microbes in the rats that succumbed although they were injected with samples from houses most likely to contain plague microbes.

154. You never detected them outside a plague patient; that is what it comes to?—No, not up to now.

155. And your method is entirely dependent upon the selective action of the rats?—Yes. The rat selects these microbes, even when by means of cultivation no trace of plague microbes is revealed.

156. Have you any evidence as to the possibility of the plague bacillus multiplying in milk, or in water?—I can answer with regard to milk. In milk the plague microbes grow slowly. The milk does not get coagulated. It is, therefore, possible to have milk which will appear to be a fresh sample but will contain plague microbes. I have not made observations with regard to water. Experiments are being made in my laboratory with regard to the growth of plague microbes in one particular product of milk largely used by the native community,—ghee or clarified butter. The addition of ghee to artificial cultivations increases greatly the fertility of the medium, but we are investigating now to what extent the microbes grow in ghee itself, in the form in which it is used for food. With regard to the growth of plague microbes in water, I would refer you to Mr. Hankin's experiments.

157. Have you any evidence as to the possibility of a man getting plague by the mouth, by swallowing, say, milk, which has been contaminated by the plague bacillus?—No.

158. (*Mr. Cumine.*)—When the inoculation experiments were being performed, I suppose as each person was inoculated his name was entered in a register: was that so?—Yes.

159. So that you have the total number of people inoculated?—Yes.

160. To what extent was a watch kept upon them to see whether they remained in the town? That, of course, would affect the percentage.—This differed in different experiments which I enumerated yesterday. For instance, the figures I have given with regard to the jail referred to a number of individuals of whose presence we were certain. Then as to the experiments at Daman. The Government in Goa got alarmed as to whether inoculated persons were not likely to prove a source of infection to the uninoculated, as at that time they were not aware that the inoculations were done with dead cultures. An order was telegraphed from Goa to the Governor of Daman to the effect that the inoculations should not be arrested, but that the rest of the population should be effectively separated from the inoculated group. Daman is divided into two parts by a river. One is Upper Daman, and the other, where the inoculations were applied, Lower Daman. By order of the Portuguese Government a cordon was put along the river, and no persons from Lower Daman were permitted to go to Upper Daman. This was done on the 23rd of March 1897, the very day when the inoculations were begun. At the end of the week, on the 30th of March, the Government of British India put a cordon along the frontier,—on the British side of Daman; so that the population of Lower Daman was entirely segregated from the rest of the country, only isolated persons under great restrictions being permitted to leave the place. In Undhera, the results which I mentioned refer to persons whom we saw personally on our visit. Every member of the family was brought before us,

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and explanations given for those few who were absent. The absentee had been sent on an errand, or was just then in the hospital, or had died. It was therefore certain that all the villagers who were counted as present had been there during the course of the epidemic. No such information is available with regard to the people in Bombay. In Kirki, the observations referred to the native followers of the Artillery. The heads of the families had to appear for the muster; and every evening they were examined medically. Apart from that we had made a detailed census of the population including women and children; and during the epidemic and at the end of it went many times over the 27 blocks where they lived, verifying our census. We have ascertained that a certain number of inoculated and of uninoculated did leave the locality, in this case as well as in Lanauli, where the information refers also to a population registered by a preliminary census, and which was investigated by daily house-to-house visitation. But in connection with this question a change has taken place lately when compared with the former state of affairs. At present some exemption from restrictions is accorded to inoculated persons when travelling, and a certain number of people who have to undertake a journey will undergo the treatment of inoculation with the object of leaving the place, whereas, up to the time when those privileges were afforded, the tendency was just the opposite. Everyone who could afford to leave an infected town did not undergo the trouble and discomfort of inoculation: it was only those who were obliged to stay on who submitted to it. An increase of the epidemic frightened away much more people among the uninoculated than among those who had voluntarily undergone inoculation believing in its protective power. This circumstance corroborated *à fortiori* our conclusions as to the comparative percentages of attacks and deaths. However, in the most important of the cases which I quoted as experimental cases, the presence of the people was actually ascertained.

161. The register would show the number of people that had been inoculated. You say the number of uninoculated people in any one of these towns has been ascertained?—In Lanauli, in Kirki, we filled up what we called House-to-House Investigation Sheets, that is to say, a paper referring to each particular hut. When the inoculations were begun, a detailed census of the inhabitants of each hut was made. On each paper we have the exact address, the names, sexes, ages, occupations, castes, and so on, of every member of the family, whether inoculated or not, and the date of the inoculation with regard to those of them who were inoculated. Similarly, before we started the inoculations, a detailed census was made by the Baroda authorities, for the village of Undhera, giving details of the population family by family.

162. That was kept up by daily visitations or was the census made once for all?—In Undhera, at the time of the enquiry, towards the end of the epidemic, we had the census before us, and we called out all the persons, and saw them in body, or had a satisfactory account given of those few who were absent. With regard to the jails, no further explanation is required.

163. In the case of each daily death, was it ascertained as regards each corpse whether the person had been inoculated or was uninoculated?—It was ascertained first of all by the parties who removed the patients, by the hospital authorities, and afterwards by ourselves, on reference to the registers. In the investigation at Undhera, the whole Committee was going from hut to hut, and Major Bannerman called out the names of the persons, and asked whether they were inoculated. It was already stated in the register whether the person was inoculated or not; but in order to verify the statement the person was always asked whether he was inoculated or not, and the statement was verified by the information put down in the register. The procedure referred also to those of the members who, in the interval, had died. The information as to death had been put down in the same census register, which contained, against each name, the statement as to inoculation or non-inoculation. In the two jails, again, the information as to inoculation or non-inoculation was absolutely complete. A detailed answer to your question, referring to the procedure adopted in each place separately, will be found in the report which I have written for the Government of Bombay, giving just the information you ask, namely, how the investigations in each particular case of the observations was carried out.

164. I think the facts with regard to Hubli are not within your personal knowledge?—No, a detailed report has been sent to Mr. Wingate.

165. You gave us figures comparing the attacked percentage and the mortality percentage of the inoculated; and also the attacked percentage and the death percentage of uninoculated people in the same town. Could you prepare any figures showing the total for those towns in which experiments were performed as against towns like Thana, Sholapur, Surat, and Satara, where no inoculation experiments were performed? The object of my enquiry is to see whether the total result (putting the inoculated and the uninoculated together in a town where inoculation experiments were tried) compares favourably with the total result in a town where no inoculation experiments had been tried.—The answer to this question will be vitiated by the fact that until quite lately my personal attention was always directed to applying inoculation to places where the disease took a severe turn. It was obvious that no evidence as to the efficacy of inoculation could be obtained by applying inoculation in places where there were only a few cases of plague. In the first plague epidemic of the two most severely affected places, Cutch-Mandvi and Daman, I made an attempt to apply inoculations in both. We did so in Daman, but I did not succeed in Cutch-Mandvi. Dr. Yersin was applying his antitoxic serum there, and Lieutenant-Colonel Wilkins, who was in charge at Cutch-Mandvi, telegraphed that it seemed desirable to avoid a possible confusion of results. When the plague began to increase in Lanauli and the number and frequency of the attacks appeared alarming, I at once obtained permission to go and operate there as I described yesterday. In the little village of Undhera, containing, on the 5th of February, 1,029 inhabitants, 79 deaths occurred up to the 14th of that month, *i.e.*, in 8 days, and it was because of that excessive mortality that the Baroda authorities thought it to be a good place for testing our method. While the inoculations were applied in an experimental form, all the operations were directed towards the most affected places. Even when the inoculations will spread, and a spontaneous demand for them arise, only few inoculations are likely to be done in places where the disease will take a mild turn. I do not think that conditions will soon and easily arise where it might be possible to make the comparison you mention. On the other hand, there are only few towns where, up to now, the inoculations have been applied to a sufficient extent to influence the course of the epidemic as a whole. In the majority of cases the inoculations were limited to a well observable group of people, and were not extended over the whole city, and it is impossible to appreciate the effects of inoculation in this manner.

166. Did you give us the figures for Hubli for the week ending 26th of September?—Yes, I did so yesterday.

167. Have you got them here?—No.

168. Do you remember what the total number of deaths in the week would have been if the death-rate amongst the inoculated had been the same as amongst the uninoculated?—It would be very large.

169. Is it larger than has been reached in any town where no attempt at inoculation at all has been made?—I do not know exactly, but it was exceedingly large.

170. Have you made any experiments in a plague-stricken room, where plague-stricken people have died, to find out what particular part of the room the microbe is in?—Will you permit me to complete by one remark the observations on the previous point? Mr. Hewett very rightly observed already that the number of inoculated people increases when the plague increases; that it is impossible to expect that a very large number of people will be inoculated in a place where there is no plague. In the Madras Presidency, a considerable number of people are being inoculated before any cases of plague occur; but there cannot be any doubt that the numbers will increase rapidly if the plague becomes indigenous there. In a town like Hubli, it not only becomes possible to inoculate the whole population, but they are ready to pay for it, as they do now all over the Dharwar district.

171. You say that for the week ending the 26th of September at Hubli the death-rate among the uninoculated was so and so, that a large number of people died; and that amongst the inoculated the death-rate was low; but if these people had died at the same rate as the uninoculated, a very large number indeed would have died. As a matter of fact, in any town where no inoculation experiments have been performed, has there ever been such a high percentage of deaths as there would have been in Hubli in that week had no inoculations been performed?—It is possible that I do not understand the question rightly, but if it implies the hypothesis that it was owing to the large number of inoculations performed in Hubli that so many of the people were infected, the answer is that that is an impossibility, because the inoculation is done with a dead culture not capable of propagation. Inoculation could not produce the plague. The opposite was the case. Because the place was so badly affected so large a number of people came to be inocu-

lated. But, I regret, I have no further data on the subject, and am unable to analyse the facts with further detail. With regard to the question, whether I made experiments to ascertain which part of the room was infected, I may say that we did make experiments, and we are now pursuing them further, but we have never succeeded in detecting plague microbes in any part of a room, although they must be there.

172. I think you said that, although you could not detect the microbes, yet when you administered the stuff to rats, they did get the plague?—They got plague when we artificially added a trace of plague microbes. The inference I draw from that is that there was no presence of the plague microbes known to us in the materials not so contaminated artificially.

173. Could you tell us from actual experiment what is in practice the effect of light and air in a room in which people have just died of the plague?—We are now carrying out experiments from which we may gather an approximate idea of the effect of this measure. We are going to expose artificial cultures of plague microbes in houses with untiled roofs, or where the roofs have been entirely removed, with houses on which the tiles on the roofs have been left in place, and to see whether any noticeable difference will be observed in the life of these cultures. Also the general microbial flora of such houses will be compared.

174. (*The President.*)—Will these experiments be available in the course of two or three months?—A number of them will certainly be available.

175. (*Mr. Cumine*).—Have you made any practical experiments in a native house to ascertain the efficacy of the disinfectant ordinarily used, perchloride of mercury?—I would refer you again to Mr. Hankin's experiments, but in my laboratory experiments in that direction have been instituted lately also, and the result, I hope, will be put before you.

176. Have you experimented practically in order to find out what the effect of cow-dung is upon the microbe, and upon the mercury respectively?—These are included in the experiments carried out now in the laboratory.

177. Have you made any experiments to see how long the microbe could live if you put it into the cow-dung floor of a room, and left the room shut up for some days?—These experiments are being made now.

178. Is this inoculation an operation that requires great skill or could any ordinary Hospital Assistant be trusted to do it effectively?—It requires very little skill. The operation itself is simple, and it is possible to teach any one to perform it. There are a certain number of rules, however, which have to be followed faithfully, in order to avoid any possibility of accident.

179. (*The President*).—The difficulty lies in standardizing?—Partly that. It is necessary to observe the temperatures of the people, but Hospital Assistants are taught to take temperatures and do that daily in the hospitals. Of course, whether they take the trouble of following these observations remains to be seen. The medical officer however is only called upon to decide the question himself in exceptional cases. In ordinary practice the instructions as to the dose on the bottle should suffice.

180. (*Mr. Cumine.*)—You said that the personal equation influences the effect of the fluid—the personal characteristics: one man gets 99 degrees of temperature and another man gets 104 degrees: has the man who gets 99 degrees been protected or not?—Yes. I expect that he is, provided the result is not due to the weak material, or the small dose used in his case. The property of producing fever differs in different persons. Very often in India one comes across a person who is able to say that during the whole of his life in India he never had fever. In many instances this may be due to that person having escaped infection. Up to the time when I undertook the inoculations against cholera, I was not aware that there are persons who in their constitution have some power to neutralize the causes which produce fever, even when the cause itself, the fever producing agent, is notoriously introduced into them. With such persons I tried repeated inoculations with increased doses of the material. I met whole families that remained free from fever after inoculation with a material which caused fever in all others. So when we inoculate an isolated individual, and do not produce fever in him, we are not certain that the material had not the requisite power of producing the sought-for effect. It is only when we inoculate a whole group, say a dozen persons, and do not produce fever in any of them, that we know the doses or the material were too weak.

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181. Was there no local action in these cases?—Yes; there is a local reaction. They have pain and swelling at the seat of inoculation, but there is no rise of temperature, or very little of it.

182. You do not think that rise of temperature is necessary to produce immunity?—Not in every isolated instance. When I stated that we took the temperature as a guide, I did not want to state that it is the rise of temperature which is the machinery by which the immunity is produced. Only when we accept that as an indication, we ensure uniform results.

183. (*Prof. Wright.*)—I want to ask you a question or two arising out of Mr. Cumine's question. When you have a number of people and inoculate them, then you are satisfied you say when the average temperature obtained is 102° and when some of the inoculated get a temperature of 99° and others of, say, 105°. Mr. Cumine has enquired about the people whose temperature does not run up beyond 99°. He has asked whether these persons are immunised. I want to enquire about the people whose temperature runs up to 105°. Are these more immunised than the rest? Can you state from your statistics whether any of those who afterwards took plague were people who had a reaction up to 105? With regard to this point facts ought to be accessible?—Very few people give such a high reaction; I have never instituted the enquiry you mention.

184. You said that in Kirki and Lanauli the results were unsatisfactory, and that 50 per cent. of those who were attacked after inoculation died. I think you said their inoculation was done with vaccine which had been kept for some considerable time. Was the vaccine in these cases standardized by the same methods as the vaccine which gave you your successful results?—The results in Lanauli and Kirki, though lower than in some other places, were not at all unsatisfactory from the point of view of the reduction of the number of deaths; but I had to increase for that the doses to 6 and 10 c.c., which means that I standardized the material as being of about ⅖ and ¼ strength. The proportion of cases to deaths was weaker than in Bombay, which may be due to a defect of the material not compensated by the doses. I had, however, to use that material because I had no better.

185. Supposing you have a quantum of immunising substance which will, when injected, give a temperature of 104°: supposing that this quantum is diluted in 20 c.c. of water, is it less effective than when it is given in a more concentrated form, say in 5 c.c.? I take it that there are two ways of standardizing a vaccine. I take it that it may be standardized by merely measuring off a certain bulk, and I take it that it may also be standardised by measuring the amount of fever reaction. I take it further that it was this latter method which was employed at Kirki, and I take it that the 10 c.c. inoculated at Kirki was the quantity which sufficed to give on the average 102° of temperature. Why then were these people not so well protected as the people who got 100° of temperature with a smaller dose of a more concentrated vaccine?—The necessity of producing a high fever impressed itself upon me by the Kirki experience. The dose of 10 c.c. used in Kirki failed to produce sufficient fever, and the reduction of mortality by 77 per cent., when compared to that of 89 per cent. at Undhera, or 85 at Lanauli, was also lower. The 10 c.c. in Kirki did not give the same reaction as the 2½ c.c. in Bombay or Mora; but 15 or 20 c. c. perhaps would.

186. In Kirki you did not take the fever as the standard?—I had already an impression that these indications should be taken into account, but I did not push the treatment far enough.

187. When the doses were standardized in Kirki, they were then not standardized by the temperature produced in the patient; were they then standardized in some other manner?—No, not that. I produced a reaction, but the doses were already bulky, and I did not insist upon producing a more marked effect.

188. You went by temperature, but you took a lower temperature as your standard?—Yes, that is exactly the case.

189. (*The President.*)—You had not enough strong material?—I had no strong material whatever at the time.

190. (*Prof. Wright.*)—Therefore a lower standard of temperature was exacted, that is what I wanted to get at?—That is precisely the case.

191. You have spoken about local immunity being acquired in horses by local injection: you got a certain amount of local immunity by these injections?—Yes.

192. I understand that if you had it in the flank low down, that local immunity would not only be in the flank, but in

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the groin and lymphatic glands to which the material has been carried?—Possibly.

193. If a man gets a bubo after inoculation, does he get it on the side which has been inoculated or does he not?—Yes, very often. When the inoculation is done in the flank, very often the glands in the groin or axilla of that side get swollen and tender for a short time. This happens when the inoculation is done in the flank, and is scarcely ever observed after inoculation in the arm. I know of only one report of a case of a gland swollen after inoculation in the back of the arm.

194. You produce general immunity by means of these inoculations; in addition to that, do you produce upon the top of this a certain additional local immunity, or do you not? In other words, am I to understand that if I get vaccinated my whole body will become immune, and I shall obtain in addition, if I am vaccinated on my left side, a certain excess of immunity on my left side as compared with that which I obtain on my right side? Are there any facts which go to show that?—Yes. The facts which are referred to at the beginning have a bearing on this question. As far as the immunity is manifested by the skin not getting sloughed, there is such a difference between the side in which the serum is injected and the other side. In a horse, for instance, I inoculate gradually larger and larger doses in the neck, without producing mortification of the cutaneous tissue: but when afterwards I inject a large dose in the flank, the skin at the seat of injection may slough off from a dose which would not produce that in the neck. Concluding from this to the case of a man, if I, on several occasions, inject into the left flank, I should produce an immunity of that kind, which would not extend to the other side.

195. Supposing an inoculation on the left side confers an additional immunity upon the left side, as compared with the right side and assuming, as I understand to be the case, that most people get affected in the legs and develope inguinal buboes, would it be possible by inoculating on both sides low down in the flank, to confer this additional local immunity upon the lower part of the body, which is the most exposed apparently to the infection?—The answer to this question depends upon the following consideration: how far that local immunity, or immunity against the mortification of the tissue, stands in connection with what should be called immunity against a specific disease? I mentioned yesterday that the local effect of the anti-plague inoculation is undistinguishable from the local effect produced by inoculation against cholera for instance or by inoculation against typhoid. It is possible that the kind of immunity which is expressed in resistance to the sloughing of the skin does not represent any specific immunity. Since we do not know for certain in what connection this local immunity stands to the general immunity against disease, it is impossible for the present to give a certain answer to your question.

196. (*Dr. Ruffer.*)—Is it the same kind of local immunity that you would get against a chemical substance,—for instance against croton oil? You might get a local immunity for a year, and yet the body would not be immune against it altogether?—That is possibly so.

197. (*The President.*)—Whatever the toxin you are dealing with, you get this local action?—Yes, apparently it is common to the introduction of bodies of any microbes under the skin.

198. (*Prof. Wright.*)—With regard to your operations among the Khoja community, in view of the fact that there were more deaths from other causes than plague in the uninoculated portion of the community, it has been suggested that you had in your non-inoculated community a community which was far more sickly than your inoculated community; in other words, it has been suggested that you left the sick uninoculated, and that you inoculated only the healthy, and that the good results you obtained may have been due in part to this fact. In order to ward off that objection to your experiments, I understand that you have put forward the suggestion that possibly your plague inoculation exerts a protective effect not only against plague, but against other diseases also?—Yes.

199. I should like to have the facts upon which you base that?—That suggestion was made, however, not in order to ward off the objection you mention: on the contrary, that objection is to be admitted and has been admitted in my report.* When the inoculations are done under conditions under which they were done in the Khoja community, that is to say, when one has a fixed inoculation station, and people come to be inoculated, most certainly the general health of the persons may have an influence as to the selection of those who choose to be inoculated. That influence may be twofold, not always in the direction of excluding the sickly people. On many occasions, while performing inoculation against cholera in villages, I had persons coming from 15 or 20 miles away, with all sorts of complaints, as they heard that a European doctor was giving medicine against disease. You may tell them that the inoculation is not a medicine against rheumatism, or chest complaints, or old age, but only against cholera; still you will find people who will be certain that it will do them some good. They will go for inoculation only because they do not get relieved in any other way. But of course in an investigation like the one we are conducting at present it is the other possibility that has to be guarded against,—that of sickly persons abstaining from being inoculated because they are afraid of the effect upon their health, and it stands to reason that the number of such people should be larger. It was with this consideration in my mind that I excluded from the comparison all the deaths amongst uninoculated Khojas of children below three, and old people above 61, although there was a large proportion of children and old people of those ages represented in the inoculated group. In this way, 61 deaths out of a total of 171, *i.e.*, more than one-third of the deaths in the uninoculated, were excluded from the comparison. This had the tendency of compensating the figure referring to the uninoculated for the deaths in sickly people; but, of course, whether it compensated it entirely, I had no means of knowing. I stated, however, that in addition to other reasons for the low mortality in the inoculated from causes other than plague, there remained the possibility of the inoculation influencing also some other infectious fevers. I admitted that possibility, because of the direct observations I had made. The inoculators are told they should abstain from inoculating any persons who have fever at the time, or had an attack one or two days before they presented themselves for inoculation. I was on several occasions consulted as to whether it was safe to inoculate a person who suffers chronically from fever, and with regard to whom one cannot wait until this condition will be over. To quote a concrete instance, Mr. Kaka, living at Breach Candy, suffered from a daily rise of temperature, and consulted his medical adviser, Dr. Temulji Nariman, as to whether it was safe for him to be inoculated. I wanted to see that patient myself and, having listened to his history, I decided to give him a reduced dose. A few days afterwards Dr. Nariman reported to me that the patient had a rise of temperature, as is usual after inoculation, that during the next day his temperature reached normal, and that since then he never had another attack. I saw the patient two or three weeks afterwards (I have the exact date), and he continued having a normal temperature. I then administered him a full dose as a second inoculation, and learned afterwards that, after the usual reaction, his condition continued perfectly normal. I have not heard his history lately, but for a long time Dr. Nariman reported that that man never had another rise of temperature. A similarly striking instance was the case of the wife of a Hindu member of His Excellency's Council. For a long time she used to suffer from fever which did not yield to quinine and arsenic. When the rest of the family were inoculated, she was inoculated also, with a reduced dose. She had a higher temperature for a day or so, and then the temperature went down. She continued to have fever as usual, but at a lower degree. Whilst previously the fever used to reach some 102°, it was reduced to between 100 and 101. A second inoculation was performed. She still continued to have fever, but at a lower degree, for a short time, and then the fever left her. Six weeks or a couple of months ago I saw her husband, and he told me that for four months after inoculation she never had fever, but started it again afterwards.

200. (*The President.*)—Had she never been free for four months before?—I am not aware of that, but in the instances I quote the fever left the patients abruptly after inoculation. The facts collected up to now are not at all numerous, and I do not think they would justify any conclusions whatever. They were sufficient only for me to devise a scheme of exact experiments which will solve this question in a sure manner. In the report in question I only foreshadowed the possibility of such an effect, and, to that extent, I believe, my surmise is correct.

201. (*Dr. Ruffer.*)—You have never noticed any serious evil effects from your inoculations?—I never noticed effects

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* See Appendix No. IV in this Volume.

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which could be ascribed with any reason to inoculation, but you must be prepared, when we inoculate large numbers of people of all ages, and when we adopt a rule not to refuse inoculation to persons suffering from chronic diseases, to find that there will be a number of incidences of sicknesses and deaths among the inoculated not at all due to inoculation. The average mortality in Bombay, in a year free from plague, is between 25 and 35 per thousand per annum. For every person who actually dies we may reckon safely upon three or four who for the first time in their life contract some ailment not actually conducive to death. During the first months of 1897 we inoculated in Bombay over 8,000 persons. This, in the ordinary population, represents a community which should lose, in a year, at least 200 by deaths, and where 600 or 800 should contract some ailment. If one divides that number by 365 days in the year, it appears that every day there must be some two or three people among the inoculated who for the first time in their life will start some disease, whether they had been inoculated or not. Inoculation, even if it has some influence on the general resistance to microbial infection, is not likely to markedly influence the general mortality. I had reports of persons who, after inoculation, complained of having pain in the joints, or a renewed attack of rheumatism or other complaints of various kinds; but I never had an indication that the percentage of those persons among the inoculated was larger than is the percentage in the ordinary course of events. A striking demonstration of this fact is presented by the state of affairs in the Khoja community already quoted: not only has the general mortality not been increased by the inoculations, but the inoculated showed a most inexplicably low mortality.

202. Have you had any abscess or erysipelas or any local conditions after inoculation?—I have not seen a single case where there has been an actual abscess, but I have had one case, which came under my direct observation, in which a nodule produced by inoculation remained unabsorbed for several months and afterwards opened spontaneously, and healed up. That was the only instance that was ever shown to me either in Bombay or in the mufassil stations which I visited.

203. You have no evidence showing that the prophylactic against plague predisposes to other infectious diseases? I ask this question because it is one which is perpetually being brought up with regard to vaccination and which is sur to be asked?—The statistics of the general mortalit collected in the Khoja community are the only accurate facts bearing upon the case. The answer they suggest is decidedly a negative one.

204. You have no facts showing that in some cases such diseases as erysipelas, syphilis, or tubercle, or any other disease has been transmitted by inoculation?—No; there is not a single indication to that effect.

205. There has never been any other infectious disease transmitted by accident?—No, as far as all my information goes. You will find in my report* on the Khojas that, although amongst the inoculated only four died from general diseases, and only three of plague as compared with 171 deaths in the rest of the community, a medical man made a suggestion that one of the persons who died from diseases other than plague, namely from consumption contracted the disease because she had been inoculated three or four months before the appearance of symptoms. I pointed out in answer that the fact of her having had consumption after inoculation is not an indication that inoculation caused it, as, when comparing the number of deaths which occurred amongst the inoculated and the uninoculated, there are no facts to show that the cases of consumption amongst the inoculated were larger than amongst the uninoculated.

206. In the case you mention there was no tubercle or lesion at the seat of inoculation?—Nothing absolutely to put in connection with the fact of inoculation, except that she had been inoculated, and three or four months afterwards she developed consumption.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Secretariat, Bombay.

THIRD DAY.

Thursday, 1st December 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (*President*).

MEMBERS:

MR. J. P. HEWETT.	MR. A. CUMINE.
PROF. A. E. WRIGHT, M.D.	DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

SURGEON-GENERAL BAINBRIDGE called and examined.

Surgeon-General Bainbridge.

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207. (*The President.*)—I understand that you are in the Indian Medical Service and Surgeon-General with the Government of Bombay?—Yes.

208. You have had considerable experience with the plague?—I have had experience in this way, that I have received a large number of reports from officers on plague duty under other officials. I have seen a great deal of the work in the hospitals, and the management of the hospitals; but I have not had any personal experience of the preventive and other sanitary measures in dealing with plague.

209. I understand you wish to say something especially with regard to the progress of the plague?—I put that as one heading of several points to which I wish to allude. I wish to say in the first place that we know very little about the life history of the plague, its mode of growth and spread, and the mode in which it affects human beings and certain animals, and I should like to say that I think that inquiry into those points is most important with a view to enable us to deal accurately and thoroughly with the plague. We have not sufficient knowledge, or the knowledge we might perhaps have, to guide us in our methods of treating the plague. We want more laboratory inquiry and investigation.

210. You are referring especially to the bacillus?—Yes.

211. Are there any special points with reference to the life-history of the bacillus which you think have not been obtained, and which it is very desirable should be obtained?—Yes. We do not know in what substances or what places it chiefly exists and grows. We do not know

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* See Appendix No. IV in this Volume.

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the way it spreads from place to place, or the way in which it invades the human organism.

212. Have you any information upon those points that you can place before us?—I fear not, at present.

213. I think you wish to say something with regard to the sanitary measures to be adopted in dealing with the plague? —Only with regard to those already referred to in my report on the epidemic in Sind.* I do not think it necessary to allude to any others than those therein mentioned. I would only say that the reports from other officers in the Presidency Proper, who have sent in their experiences to me, perfectly agree in supporting the measures which have already been adopted in dealing with plague.

214. I think you have interested yourself in the question as to the intervals between the date of importation and the occurrence of an epidemic in any place?—It seems that between the date of importation of plague into a town or village an interval of several weeks elapses before the disease becomes localised. It appears as if the germs lay dormant for a time, or took some considerable period to acquire potency.

215. Can you illustrate that in any way?—I can only illustrate it by figures. Captain Grayfoot who first drew attention to the point has prepared maps, and is more familiar with the matter than I am, and the information might be acquired from him. I have given in my report, which is before the Commission, some few particulars in regard to the point.

216. I think you also wish to say something with regard to the plague in rats, and other animals, and the spread of the disease by them?—I have alluded to that also in my report. Rats are largely affected by the plague. Before an outbreak in a locality the rats become ill and die, as I understand, from plague. The illness of human beings with plague follows very closely upon the death of rats in or about the dwellings. These facts, I think, are known to every one who has had dealings with plague.

217. Do you know the interval that elapses between the death of rats and the appearance of cases of plague?—A few days.

218. Two or three days or more?—I should say about a week, perhaps not less than a week.

219. Is it always the case that the outbreak amongst human beings is in that actual locality or somewhere else?—There are instances of the outbreak in the same spot as the rats die.

220. Are there instances in which an outbreak has not occurred in that locality, but in some other locality?—I do not know of any. I noted a few instances. Captain Hudson was working on plague duty at Thana, and he reported many instances, showing the connection of the illness of rats with plague outbreaks in human beings. He mentions one in which the occupants of a house, none of whom had had plague, evacuated it, owing to the death of rats in it. A few days later two men were sent to clean the house, and they found a large number of dead rats in the room. Within a few days both of these men were attacked and died of plague. This is only one instance. I know that numbers of other similar instances can be produced.

221. I believe there are several instances of that kind. Have you any information regarding the channels by which the virus is admitted into human beings?—It has been asserted that the plague in the human being is always acquired by external inoculation. I have not been able to adopt that view for several reasons. I have recorded them in my report.

222. Would you kindly favor us with your views?—The first reason which I adduced against external inoculation being the usual mode of invasion is the frequency with which whole households have been attacked, or several members of a household have been attacked within a very brief period of each other. The attacks in families are often simultaneous or almost simultaneous. I do not think this coincidence would be likely to occur if the acquisition of plague by external inoculation were the rule. I find here there are 277 instances representing more than 554 persons in which more than one attack occurred on the same day as others in the same family or dwelling, or followed a previous case within 10 days. The intervals between attack and such preceding cases were as follows:—The numbers attacked on the same day as the previous case were 122; one day after, 58; two days after, 34; four days after, 18; and so on in gradually diminishing numbers: showing that at each focus of the disease the inhabitants were attacked to a great extent simultaneously or within a very few days of each other.

223. I thought you mentioned the time as 10 days?—Yes, all within 10 days.

224. What do you mean by attack; how do you judge?—The first early symptoms.

225. What do you consider the period of incubation?—Within 10 days. The usual period is within four or five days.

226. Therefore the incubation varies very much, sometimes a few days and sometimes 10 days?—I do not think it varies very much. In the majority of cases it does not vary beyond four or five days.

227. Four or 5 to 10 days?—Yes. The number of cases after the fifth day is very small.

228. Supposing there was inoculation in a group of persons, and the period of incubation in individuals varied, you would naturally expect that some of the cases should occur in four days, some in five, some in six, some in 10, even though the causes were external inoculation?—Yes; but I contend that the simultaneous inoculation, by the skin, of several persons in a dwelling or family is less probable than their simultaneous infection by the lungs.

229. Can you tell me how that illustration you have given us supports your idea that there is no external inoculation?—Because I think that it shows that those attacked were exposed to the same influences, at or about the same time.

230. Might that not be external inoculation, as well as anything else?—I do not think that. The aerial pulmonary infection is far more probable. I am distinguishing between external inoculation and infection by the lungs,—I mean cutaneous inoculation, or inoculation by a mucous surface as distinguished from inhalation.

231. By external inoculation, do you mean through the skin surface?—Yes, mainly the skin, or an exposed mucous surface. I should distinguish between the taking in of the bacilli through the walls of the minute blood vessels, or possibly of the minute bronchiolæ as against inoculation through a cutaneous or ordinary mucous surface.

232. Your idea is that the majority of cases are inoculated in that way?—Yes. If you would permit me, I should like to say a little more upon the subject. I say it is difficult to believe that a large proportion of the inhabitants habitually have lesions of their skin (even though they might be very minute), suitable for the absorption of the infection. In ordinary septicæmia, a definite lesion is usually considered essential. I find it difficult to believe that the large majority of people attacked with plague have such considerable lesions in the skin.

233. Do you require a large lesion of the surface?—Not a large lesion, but professionally speaking a more or less definite lesion. I also say that if inoculation were by a very slight cutaneous lesion, the common mode of infection would be more destructive than it is, because these very slight lesions, scratches, and so on, are exceedingly common. These people who go about with naked feet and who are not too cleanly with regard to their hands and other parts would, I think, be much more frequently attacked with plague owing to the presence of those slight lesions, abrasions, and so on, if that were the usual mode of infection. Then, I think that when once plague has established itself in a place, by the occurrence of a few local cases, the disease spreads much more rapidly than it would do if infection by external inoculation were the rule.

234. There are certain definite local manifestations, are there not, swelling of the glands, buboes, and so on?—Yes distant from the supposed seat of inoculation.

235. Do you think that has any relationship with the seat of inoculation?—I greatly doubt it.

236. I suppose you know that that view is entertained by some people?—Yes. I have seen no reason in support of the supposed connection between the local infection, and the implication of the system.

237. Your opinion is that the infection is acquired chiefly through the lungs?—It is. I should like to add one thing. The duties of women tending on the sick amongst the people, bring them into much closer contact than the men with possible sources of infection by inoculation, but they do not suffer in larger numbers than the men: the proportion

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* "Report on the Plague in Sind, 1896-97, by the Principal Medical Officer, Sind District"—not reprinted in the Proceedings of the Commission.

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of attacks are about equal, or, if anything, are fewer amongst the women than amongst the men. The same argument applies to the case of hospital attendants, who are constantly handling the sick, their discharges, their dirty linen, and their infected belongings and who are attacked in but a very small proportion. In hospitals the conditions remain favourable to cutaneous inoculation, whilst those which favour infection by inhalation are greatly diminished. I think that analogy is against cutaneous infection in plague. Thus in typhus fever, which plague most resembles, the evidence points to infection by inhalation, whereas in those diseases in which cutaneous inoculation is possible or usual, local signs of infection are the rule except in tetanus and hydrophobia, which differ greatly from plague.

238. With regard to the prevention of the spread of plague, would you kindly give us your views?—I think I may say that generally I am in favour of the usual recognised sanitary measures which are sanctioned by the profession for dealing with other infectious disorders.

239. General sanitation?—General sanitation, and measures of sanitary police, which are included.

240. That is with regard to all infectious disorders. With regard to plague, have you anything special to suggest?—In the first place I think the sick should be isolated as early as possible, the occupants of the houses segregated, and the houses cleansed and disinfected as far as possible. With regard to preventing the spread of plague to a distance, I consider that travellers from infected places should be examined, and, if necessary, detained, or kept under surveillance, their destination notified, and surveillance kept over them. With regard to notification and surveillance, however, I do not think that the agency available in this country is sufficient or suitable for the general application of the measure. I think that to a certain extent notification and surveillance are practicable; but if it were necessary to prolong the system, a very much larger and altogether different agency from that now in use would be requisite. Our available staff for notification and surveillance now is a make-shift arrangement altogether; and the country is not prepared as yet, either as regards the habits of the people, or as regards the staff at the disposal of the Government, to introduce such a system.

241. Do you think that it is desirable, but that it is impossible?—I think if notification and surveillance could be adopted they are very desirable as a substitute for more stringent measures.

242. They have been adopted, I understand, to some extent?—They have lately.

243. Have you anything to say about disinfection?—As far as I can judge, disinfection is most important,—disinfection of the clothing, and, possibly, of the person.

244. Disinfection of the house?—Yes, of the house certainly.

245. Have you any experience as to the kind of disinfectants?—I cannot give much practical evidence with regard to that; but the perchloride solution seems to have been satisfactory.

246. I suppose you have a general supervision of the hospital arrangements, have you not?—I have had in certain places.

247. Do you regard them as satisfactory?—Very good considering the provisions that have been available.

248. You have a large number of special hospitals for plague?—All our Plague Hospitals have been special hospitals, or ordinary hospitals which have been converted into special hospitals.

249. Do you think the number quite ample?—Yes.

250. Do you think the organisation and administration are all that may be desired?—I do not say but what it might not be improved here and there; but considering the available staff that we have at our disposal, I think the hospitals have been very well managed.

251. Will you give us a general account of a Plague Hospital: what is the organisation?—In a large town—in Bombay, for instance,—there are one or more medical officers, and as many nurses as are available. I do not know the exact proportion that has been appointed.

252. You do not know how many doctors may be employed for a given number of patients?—I cannot say.

253. Who is responsible for the arrangements?—The officers who have been supervising the whole arrangements.

254. What do you consider to be a sufficient staff for any given number of patients?—I should think two superior medical officers, to about 100,—and subordinates.

255. How many subordinates?—There would be perhaps three or four subordinates.

256. These are qualified gentlemen?—Not necessarily qualified.

257. What are they?—Assistant Surgeons qualified, and Hospital Assistants unqualified.

258. How many nurses do you consider necessary for a hundred patients?—About four. I do not think we have always had that number.

259. Are the arrangements such that night-nursing as well as day-nursing is fully performed?—The night-nursing has not in all hospitals been as good as the day-nursing.

260. Is that being attended to?—I do not think there are grounds of complaint now: it was so at the commencement.

261. Who supervises any given hospital?—The chief executive officer.

262. He also has medical duty, I suppose?—He has the executive medical duty.

263. How many beds have you in a hospital generally; how large are these hospitals?—The largest hospital at Poona had 400 beds.

264. There is no administrative Superintendent who has no medical duty?—No.

265. Do you think it desirable to have one?—I do.

266. Is there any reason why it has not been adopted?—The reason is because the plague organisation as a whole has not been under the Medical Department.

267. I thought you said you had the supervision?—I have no official supervision over the hospitals. I have my own duties to perform, and if I am in the way of visiting a Plague Hospital, I visit it, but I could not supervise the whole of the Plague Hospitals of the Presidency and do my own duties.

268. In Bombay City who does supervise the Plague Hospitals?—In Bombay I was on the Plague Committee from November 1897 to May 1898, and then I used to go round the Plague Hospitals and visit as many as I could.

269. Officially?—Yes, as a member of the Plague Committee, and as Surgeon-General; but I had no formal authority over the hospitals.

270. Supposing you saw some serious defect, what would be your function in that case?—I informed the Plague Committee at that time. Now, I have no part in the management of the Plague Hospitals in Bombay City. There is now a Special Supervising Medical Officer at the disposal of the Municipality.

271. How many special hospitals are there in the city of Bombay—Plague Hospitals?—I do not know accurately, but I think there are some 40 or 50.

272. I think, also, you wish to say something about inoculation, in the way of treating plague?—Yes; with regard to inoculation I only know about it from figures which have been reported by M. Haffkine and by various officers serving under me. All of the reports have come to me as Surgeon-General.

273. Therefore you get all of the reports about inoculation officially?—I have done.

274. Will you kindly give us any statement you may desire to give?—I have only to say at the outset that I was unwilling to accept inoculation with Haffkine's prophylactic as a certain preventive of plague, owing not to any feeling of doubt, exactly, as to its value, but from a desire to have facts in proof of its efficacy.

275. What is your impression from the official documents you have?—The figures which have come before me I accept as proving the protective value of the prophylactic. I do not accept Haffkine's inoculation as a measure of general application or as the sole or chief measure with which to deal with plague. I do not think it can be regarded as a substitute for, or can replace, general sanitary measures: it should be merely ancillary to them.

276. (*Mr. Hewett.*)—I should like to ask you one or two questions with regard to the control of the hospitals. You are entitled to inspect any hospital maintained by the public, by the Municipality, or by the Government, are you not?—I am not aware that I was empowered to inspect Plague Hospitals in Bombay City whilst I was a member of the Plague Committee.

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277. But in other Municipalities in the Bombay Presidency?—In other Municipalities, I should.

278. Is there any restriction to prevent your doing so in the Bombay Municipality?—I cannot say. I know of no restriction; but it has never been the practice of a Surgeon-General to interfere with Municipal affairs.

279. Supposing there were Municipal Plague Hospitals in other Municipalities, would you inspect them from an administrative point of view?—Yes.

280. But you consider your duties do not permit you to do it in Bombay itself, and, therefore, there is no administrative inspection of those hospitals?—No, not until Colonel Wilkins was appointed.

281. He has been appointed to that special duty?—Yes.

282. I only wanted to ascertain whether there is not some arrangement for inspecting them administratively. You said something about there being four nurses to a Plague Hospital. It would be impossible in your opinion to obtain qualified nurses to anything like that extent, except from England?—I think so.

283. You would certainly not be able to obtain them in India?—No. I might mention that there has always been the assistance of male and female attendants under the nurses.

284. I meant properly qualified nurses?—Yes.

285. With regard to the outbreak in Sind, I believe quarantine was imposed at Karachi against Bombay in the early stages of the epidemic?—Yes.

286. And did no facts come to your notice as to how the plague got from Bombay to Karachi?—None.

287. Do you believe it was brought by human beings, and not by rats, or was there no investigation?—There were no facts to guide one, as far as I could judge. The municipal Health Officers made enquiries.

288. Plague moved from Karachi to Hyderabad?—Yes.

289. And then to the top of the Province, to Sukkur.—Yes.

290. Was there not some investigation in Sukkur as regards the infection by rats?—I do not remember any official investigation. There was good evidence in Sukkur that rats were infected at and just before the out-break.

291. There is a good deal of trade between Karachi on the one hand, and Hyderabad and Sukkur on the other?—Yes.

292. Did the villages in the districts of Sind get very much infected?—Not very much. Several large towns there escaped.

293. The virulent attack was confined to Karachi, Hyderabad and Sukkur?—Yes.

984. I should like to ask you one or two questions with regard to what I understood you to say in support of your argument that plague is not communicated by external inoculation. I understood you to say that the fact that these outbreaks began very virulently is against that theory?—I do not think I said so.

295. Is it your experience that sometimes plague appears to smoulder very much at the beginning, and then suddenly to break out with great virulence?—Yes.

296. Would not that fact rather tend to show that it might be communicated by some kind of external inoculation, the soil having become infected?—I would not lay the same stress on the rapidity of an out-break in a town or in a village as on any particular local out-break in a house or group of houses.

297. In Sukkur there was only one case between the 4th and 19th February, and by the 26th there were only five cases, so that apparently there was no violent out-break there till later on?—Yes, that is true.

298. Is it not the case that in the great majority of instances in which sufferers from plague have buboes, the buboes are in the groin?—A very large proportion. I have given some figures in my report.

299. You do not think it is possible to connect that fact with inoculation on the foot?—I have not been able to do so. I think there are other reasons why there should be greater activity in the glands of the groin. The inguinal glands are prone to attack. They are always more prone to inflammation than the other glands.

300. In stating the period of incubation, I think you said it goes up to ten days, but very rarely so, I understand?—Not commonly. I have given the proportion.

301. Do you think five days would be the usual period?—Yes. There are a few figures with regard to the period of incubation which I might mention. At the Wari Bandar Camp in Bombay, which was a camp for the segregation of contacts (people from infected houses), in the three months, January, February and March 1898, 5,368 contacts were admitted, of whom 131 developed plague, that is, 2·4 per cent. Of those 131, 67 per cent. developed plague within two days after the day of admission. That is to say, on the first day after admission, there were 30 cases; and on the second day 19 cases. Thirty-nine were attacked between the third and the sixth day after admission: namely, on the third day 13 cases, on the fourth day 11 cases, on the fifth day nine, and on the sixth six cases. After the sixth day only four persons were attacked with plague out of the 131; and those four were not original contacts, but had acquired the plague in the camp.

302. How did they get into the camp?—They were admitted as contacts, but they acquired the plague from other persons attacked in the camp.

303. I do not quite understand why that necessarily follows?—Their attack is dated from day of attack of their companions with whom they had been in close contact in the camp.

304. That is possible of course; but how long after they had been in the camp were they attacked?—More than a week.

305. It was not more than ten days?—They had gone through their first eight days of segregation and those with whom they had been in immediate contact having been attacked with plague, they were put in for a second period of eight days. It was during that second period that they were attacked with plague.

306. Was it more than 10 days after they were placed in the segregation camp?—It was after the sixth day. I cannot say any more.

307. There was no inoculation in Sind?—No; not up to the time I left.

308. (*Dr. Ruffer.*)—You spoke about segregation as being a useful measure to take in case of an epidemic of plague. Supposing a case occurs in a house, would you segregate all the inhabitants of that house, or how far would you extend it? Would you only take the people actually in contact with the patient, or would you take all the people inhabiting the same house or same group of houses?—It depends upon the size and class of the house. In a small house I would segregate all the inmates, that is, a small house of one family. In a large house of good class, where several families were living, I should try, in the first instance, the effect of segregating the members of the one family attacked. In the case of a large chawl or block I should adopt the same course. As regards a group of houses, if more than one house in a group were attacked, and there were indications of the disease spreading, I should segregate the occupants of the whole group of houses.

309. Supposing you had a case of plague, what do you think would be the average number of people segregated: would it be three or four or a dozen or two dozens?—I should put it at four or five in an ordinary village house. In Bombay it might be somewhat higher.

310. In Bombay, you have had as many as a hundred cases or more a day: that would mean the segregation of 400 people each day?—That was about the figure we estimated it at.

311. Do you think under the present condition of things you could make satisfactory arrangements to completely segregate that number of people in the course of an epidemic?—We found that with the organization the Plague Committee had, we were unable to carry out the measure. That was our experience when I was on the Committee. I do not say it is impossible, but it is difficult.

312. It would cost a great deal of money?—Yes.

313. And it would be extremely difficult to carry out?—Yes.

314. I understand you have visited all the hospitals in Bombay?—Not lately, not since March last.

315. Are you satisfied with the disinfecting arrangements in the hospitals and houses in which plague has occurred?—I have never been quite satisfied.

316. Perhaps you would tell us where the disinfection seems to be inefficient?—I think there has been a want of supervision with regard to detail in the control of the disinfection.

317. Supposing a case of plague occurs in a house, would you be inclined to disinfect the whole house, or only the room in which the plague has actually occurred?—The room in

which the case occurred, and certain other parts of the house which are likely to be contaminated.

318. Do you think that the fæces and urine of plague patients should be disinfected; do you think they are likely to carry the disease?—I do not know. I cannot say from the facts whether it is necessary, but I should think it is desirable.

319. Do you think it is desirable that the clothing should be disinfected?—Yes, certainly, the clothing should be disinfected. The evidence with regard to the communication of plague through the medium of clothing is so strong that I think its disinfection is imperative.

320. Can you give any specific instance in which you know that the disease has actually been communicated by clothing?—There are many instances, but I cannot give them just now. I have one here which seems to point that way. There was a Parsee lady living at Thana. She had been there for 22 days and had not been in contact as far as she knew with any infected persons or places there. Some ladies or friends from Bombay, however, visited her, and shortly after their visit she was attacked with plague. There are a good many other instances, but I have not collected information about them.

321. Is there anything to show that those people coming from Bombay had infected clothing?—They came from infected houses.

322. You spoke about the local lesion; I understood from your evidence that you were not in favour of the view that plague was actually communicated by entrance through local lesions; you rather held to the view, as far as I can make out, that it is introduced into the system by inhalation?—Yes.

323. If your view is correct, would you not expect that the primary symptom would most frequently be in the lungs?—I do not myself understand why that should be so.

324. You think it might be, anyway?—Taking the analogy of other diseases; we believe, for instance, that certain other infectious diseases are contracted through inhalation.

325. As for instance?—I think we might say small-pox, scarlet fever, and typhus.

326. But in small-pox there are definite lesions in the lungs?—Yes; but it might be a question whether they are the result of local inoculation or the general infection.

327. In scarlet fever you get some very prominent symptoms not exactly in the lungs, but in the tonsils, over which the air would naturally pass?—That is so.

328. Except in pneumonic cases of plague these symptoms in the lungs are generally late?—In the majority of cases. There are certain primary pneumonic cases, in which, no doubt, the lungs become infected very early.

329. In the majority of cases of bubonic plague, when you have well-marked buboes, are not the lung symptoms late symptoms? Are they not noticeable towards the end of the disease only and not at the beginning of the illness?—Quite so.

330. I suppose Europeans in this country mostly wear shoes and stockings, and if the plague bacillus enters the body through local inoculation, you would expect that in Europeans the bubo would be less frequently in the groin than in other races who did not wear shoes and stockings?—Yes.

331. Can you give us any evidence as to that?—No.

332. But I suppose evidence will be obtained?—I have only seen some two or three cases amongst Europeans myself. The numbers have been so small that I do not think you could draw any deductions.

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333. But you might perhaps obtain the evidence from hospitals?—I might be able to do so.

334. You spoke about the local lesion being in many cases extremely slight, or often absent, I think?—I did not refer to actual cases of plague; I referred to the general public, the state of the limbs of the natives who go about. Visible lesions in plague cases are very rarely discoverable.

335. Noticeable lesions?—Noticeable lesions.

336. Is it not a fact that in animals you can inoculate the disease by scarification, by scratching the skin and inoculating the virus in that way?—Yes.

337. Might not a patient inoculate himself with plague by scratching his leg where there has been a mosquito bite, and in that case would not the local lesion be hardly noticeable?—It would be hardly noticeable. I do not deny the possibility of external inoculation, but I have not been able to satisfy myself that it is general.

338. Still you admit the possibility of a man inoculating himself with plague by a scratch or cut, or anything of that sort?—That it is possible, I do not deny; but I think that circumstances which would favour the infection by that means are infrequent, and the conditions are not favourable.

339. In the case which you quoted just now as occurring at Thana, you spoke of two men, cleaners, going into a house which had been evacuated on account of rats having died from plague, and a few days afterwards they got the plague and died: but at that time there was plague in the village?—There was.

340. So that one might assume that those men got the plague from some one else?—Yes. I only mentioned it for what it was worth.

341. It might also be said that they had been infected somewhere else?—That is so.

342. (*Prof. Wright.*)—You say with regard to the question of argument against external inoculation it is difficult to believe that any large proportion of the inhabitants have lesions of the skin suitable for the absorption of the infection: how large do you suppose a lesion need be in order to be suitable for the absorption of the infection?—I am afraid I must qualify that statement. I know that the lesion requisite would be very small, almost imperceptible.

343. The word septicæmia has been used; does that include plague or not?—I did not mean it to include the plague. I meant pyæmia and septicæmia.

344. The argument you bring against local infection is the fact that there was a rarity of local signs of inoculation; do you count a bubo among the local signs to which you refer?—Apart from the bubo, I mean the manifestations at the seat of inoculation.

345. According to your experience, may you not get blood poisoning without any sign of inoculation?—You may; but there is almost always some; and there is almost invariably lymphangitis.

346. Would not the whole, and not one region only of the lymphatic system be infected if the patients were infected by pulmonary inoculation?—I take it that it is always so.

347. Are there many cases in which there are buboes in both groins and both axillas?—There are many cases of multiple buboes. I have always supposed, although there might not be buboes, that the whole lymphatic system was involved. I may be wrong. I consider the occurrence of multiple buboes, external and internal, to be evidence of this, and therefore pointing rather against cutaneous inoculation.

(Witness withdrew.)

Dr. D. G. Galeotti called and examined.

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348. (*The President.*)—I understand you are a Doctor of Medicine of the Royal University of Florence?—Yes.

349. You have, along with Professor Lustig, paid attention to the preparation of serum?—A curative serum.

350. And you have seen something of its application in Bombay in connection with the plague?—Yes.

351. Perhaps you will, in the first place, tell us how the serum is prepared?—The way in which the serum has been prepared has been published in the *British Medical Journal*. I put in a copy of a paper regarding it. (The paper* was read out by the Secretary.)

352. I should like to ask if you have succeeded in preparing the horse serum referred to?—Yes; we have vaccinated a horse in Florence, and for four weeks injected into it ninety centigrammes of the substance which we obtained from the plague microbes in the way I have described. After four weeks, we extracted from the horse a small quantity of serum, about a litre and a half. With this serum, Professor Lustig and myself came to Bombay. We operated on six patients at Arthur Road Hospital, and six patients recovered, as is stated in the Report of the Municipality.† Afterwards Professor Lustig tried this serum at Poona on 24 patients. Of these 24, six died and eighteen recovered.

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* See Appendix No. VI in this volume.

† See pp. 169 and 201—2 of the "Report on the outbreak of Bubonic Plague in Bombay, 1896" by P. C. H. Snow, Esq., I.C.S., Municipal Commission for the City of Bombay.

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353. How much serum did you inject?—We injected about 60 to 80 c.c. When the epidemic was increasing Professor Lustig was commissioned by the Municipality of Bombay to prepare a larger quantity of serum, and he began to immunise four horses at Florence. After a month, I came here with the serum of the first horse, which had received a small quantity of the active substance; I do not remember exactly the quantity. After I came here Professor Lustig sent me, almost every week or fortnight, a quantity of the serum from the other horses. Experiments have been made at Arthur Road Hospital, at the Mahratta Hospital, and at Parel Hospital, and some cases have been treated also privately. I have the record of the treated cases. The serum of the first horse was very weak. Ninety patients were inoculated with this serum. Of these, 65 died, and 25 recovered, giving a recovery of 27·77 per cent. With the serum of the second horse, we treated 42 patients; of these 20 died, and 22 recovered, giving a percentage of recoveries of 52·29. With the serum of the third horse, we treated 70 patients. Of these, 32 died, 38 recovered, giving a percentage of 54·28. With the serum of the 4th horse, we inoculated 43 patients. Of these 20 died, and 23 recovered, giving a percentage of 53·48. Professor Lustig had another horse, a fifth horse, which was vaccinated twice. The serum was used only once. The serum was tried on twelve patients; and of these 8 died and 4 recovered. Afterwards the preparation of the serum was stopped. The general mortality rate is 56·42 per cent. In these were included about 30 cases, which were all in a moribund state. There were some pneumonic cases. If these cases are excluded, the mortality would be 49·76 per cent. amongst the treated cases, eliminating the 12 cases treated with the serum of the fifth horse, which serum was not strong. The serum of the first horse was not at all strong, almost inactive.

354. (*Prof. Wright.*)—How much serum did you give in each case?—A variable quantity. Sometimes, we injected 30 c.c., sometimes we have injected 120 c. c.,—these are the smallest and the biggest doses.

355. What quantities of your substance had these horses received?—The horses received about three grammes of active substance.

356. (*The President.*)—How much of that substance would be enough to kill a horse?—We did not try.

357. What do you suppose?—I cannot say. If the injection were made into the vein, a small quantity would be sufficient; but if the injection is under the skin, the horses can take a large quantity of the substance.

358. You say there were only two injections in the case of the fifth horse?—Only two injections.

359. Within what interval were those injections? What time was there between the two injections?—The injections were made about every eight or ten days.

360. There were only two injections?—The fifth horse had only two injections.

361. The interval was eight days?—Yes.

362. Professor Lustig and yourself would, I think, quite believe that you could not in that way produce a valuable serum?—I believe it is possible to obtain in a short time a very active serum by injecting a larger quantity of our substance into the horses.

363. Why did not you do it?—Because the serum was more active when obtained from horses inoculated repeatedly with a gradually increasing quantity of this nucleo-proteid.

364. Did you therefore prepare the strongest serum?—I am preparing the serum by this method. I have five horses, and I inject into them larger doses of this substance.

365. Are these horses in Florence or here?—Here in Bombay.

366. When do you think you will have a satisfactory serum prepared?—I hope to be able to get some active serum in a month.

367. How long has a probable immunisation been produced in these horses?—In horses that were inoculated three times.

368. When did you commence?—I commenced the first day of November.

369. When do you think they will be ready?—At the end of December.

370. But you cannot expect to get a very strong serum in two months, can you?—I hope to get a moderately strong one.

371. Perhaps you will be kind enough to let the Commission have some samples of the serum when they are ready?—will.

372. (*Dr. Ruffer.*)—You treated six patients with the serum of the first horse, and they all recovered?—Yes.

373. Have you tested the property of the serum on animals?—It was tried every time.

374. What was the result of your experiment on animals?—I have not myself tried it. The serum was experimented with before it was sent here by Professor Lustig. I have not the exact experiment.

375. Have you any experiment which you can place before the Commission at some future meeting?—In two months I can make experiments.

376. Could you then give us the results which you obtained from animals from those first five horses?—Yes.*

377. You have got notes of the other experiments at Florence?—Yes; I can write to Professor Lustig.

378. Were these six patients whom you inoculated (and who all recovered) consecutive patients who came to the hospital, or were they six patients which you chose?—Six consecutive patients.

379. What form of plague were they suffering from?—The bubonic form: it was not very serious. We were here when the epidemic was disappearing.

380. You treated 24 patients at Poona, of whom six died?—Yes.

381. How many of these were severe forms?—I do not know exactly, because I was not in Poona: Professor Lustig was there.

382. Will you be able to give us these results later on?—Yes.*

383. In the second series of patients which you treated with the serum of four different horses (excluding the fifth horse, which you acknowledge was not a good horse) were they all consecutive patients, or did you choose them in any way?—They were not consecutive. Every horse has a different period. For example, Professor Lustig sent me, at the same time, the serum of the first and of the second and of the third again, at the end of 15 days.

384. Did you take every patient who came into the hospital as he came in or did you choose your patients?—At the beginning we inoculated almost all.

385. What do you mean by "almost all"; whom did you exclude?—We excluded the patients who were dying. As you know patients are brought in to the hospital who die in a quarter or half an hour.

386. You excluded those?—At the beginning we did not exclude them; but it was completely useless to inject the patients with serum.

387. But I suppose a record has been kept at the hospital of all the patients which you have inoculated; there are notes at the hospital?—Yes; there is a record made by Dr. Choksey.

388. He has notes of each patient?—Yes. He has given me this record.

389. So that you exclude for instance, all the cases that were dying — that were sure to die?—Not at first. At first, we injected patients who were near to death.

390. Have you any statistics to show what was the mortality at the beginning when you inoculated everybody?—I think the mortality of the hospital was about 76 per cent., that was excluding the patients who died in the first 24 hours after their admission into the hospital. So I was told by Dr. Choksey.

391. What was the total mortality during the same period?—The total mortality of the injected patients during the period was 56 per cent.

392. But the total mortality at the time when you took every patient consecutively?—I do not know. I suppose 80 per cent.

393. (*Mr. Cumine.*)—The epidemic in Bombay varies in virulence at certain seasons, does it not; it rises and falls?—Yes.

394. Could you give us the months in which you made those different inoculations on those different people, in order that we may see whether it was upon a rising or a falling epidemic?—We made the inoculations in March, April and May and afterwards in September.

395. In the first set of experiments, six died and 24 re-

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* See the record of the re-examination of Dr. Galeotti on the 20th of March 1899.

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covered: what month was that in?—It was at Poona. These experiments were made by Professor Lustig in Poona. It was in July 1897.

396. Then we come to the second set of experiments, 90, 42, 70, 43 and 12. Were they all in Bombay?—Yes.

397. Could you give the months? I merely want to know what month the experiments were made in.—The following statement gives particulars:—

Series of the experiment.	Number of the horse.	Number of treated patients.	Died.	Recovered.	Percentage of recovery.	Dates.
1	I. 1st bleeding .	24	18	6	...	15th—30th March.
4	„ 2nd „ .	41	30	11	...	15th—20th April.
8	„ 3rd „ .	6	5	1	...	1st—14th May.
12	„ 4th „ .	3	1	2	...	June.
15	„ 5th „ .	16	11	5	...	September.
	TOTAL .	90	65	25	27·77	
5	II. 2nd bleeding .	13	8	5	...	22nd—26th April.
9	„ 3rd „ .	17	6	11	...	26th—28th May.
13	„ 4th „ .	12	6	6	...	July.
	TOTAL .	42	20	22	52·29	
2	III. 1st bleeding .	20	11	9	...	27th March—3rd April.
6	„ 2nd „ .	24	12	12	...	26th—30th April.
14	„ 3rd „ .	16	6	10	...	27th May—3rd January.
14	„ 5th „ .	10	3	7	...	September.
	TOTAL .	79	32	33	54·28	
3	IV. 1st bleeding .	8	3	5	...	26th May—April.
7	„ 2nd „ .	11	5	6	...	3rd—14th May.
11	„ 3th „ .	12	6	6	...	June.
17	„ 5th „ .	12	6	6	...	September.
	TOTAL .	43	20	23	53·48	
18	V. 1st bleeding .	12	8	4	...	
	TOTAL .	12	8	4	33·33	September.
	GRAND TOTAL .	257	145	112	...	

The general mortality rate is, as I have said, 56·42 per cent., but eliminating 30 moribund cases in which the serum was tried for experimental purposes and 12 cases, of the horse No. V, which was insufficiently vaccinated, the mortality would be 49·76 per cent. It is to be considered that the serum of the horses II, III, IV gave concordant results, *viz.*, 52 per cent., 54 per cent. 53 per cent. of recovery.

398. (*Prof. Wright.*)—Did you find that the horses which received the most of the substance gave the best serum?—They gave the most active serum.

399. How much nucleo-proteid do you intend to give the horse before you draw off the blood?—Three grammes.

400. Why do not you give 30 grammes?—Because I shall not be able to get such a large quantity in a short time.

401. (*The President.*)—Final dose, or total?—Altogether three grammes.

402. (*Dr. Ruffer.*)—Could you tell us what was the clinical effect on the course of the disease, and also the pathological appearance of the patients treated with the serum?—We have the clinical descriptions of a hundred and seventy-five cases. We have observed a great decrease in the temperature,—as much as 9 degrees Fahr. Four hours after the injection there is a decrease, and the pulse becomes less frequent. The serum has a good effect upon the delirious. Some time after the injection the patient becomes quite conscious. The serum also has an effect upon the bubo. The bubo becomes smaller, and generally disappears without suppurating. In three cases, we could coserve bactericidal power of the serum. the Were there rose of

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septicæmia. We made a microscopical examination and we found many microbes. After two injections, in 24 hours all the microbes disappeared, and the patients recovered. Two of these cases were servants of the Arthur Road Hospital. They were injected at the beginning of the disease, when they had the first rise of temperature. We made other interesting observations. We made a culture with the lymph of the bubo, before the inoculation of the serum. We tried the virulence of the cultures after the inoculation of the serum, and we tried the virulence of the microbes. We observed a decrease in the number of the microbes and in the virulence.

403. Did you notice any agglutinating effect? Did you notice any effect upon the expectoration in cases of pneumonia?—No.

404. You saw nothing like agglutination of the microbes in the sputum?—No.

405. With regard to the appearance after death,—did you notice any difference between inoculated and uninoculated people?—No. We did not make any *post mortem* examinations.

406. (*The President.*)—These improvements were seen in the cases which died as well as in the cases which recovered?—We observed a good improvement in cases which died of other complaints, and specially some cases which died after 15 or 20 days of uræmia.

407. On the whole I gather that you yourself are not satisfied that the serum you have been working with is the best serum which could be obtained by your method,—that it is not powerful enough? You think you could produce a better serum than you have done as yet?—I cannot say that. I may mention that I have observed experiments with Haffkine's curative serum, and with the serum made by the Russian experimentor in St. Petersburg. The experiments were made at the same time as ours, in the same hospital, with the same patients, and I observed a great difference between the action of our serum, and the serum of the others. I do not know the serum of Dr. Roux, and I cannot tell you anything about it.

408. I suppose you feel quite satisfied that if you could give a horse a much larger quantity of your toxin than you have given, you could get a better serum?—Yes, I believe that. I believe that if the reaction in the horses is greater, the serum will be more active.

409. I did not put it in that way. I said a larger quantity, apart altogether from reaction. If you gave a larger quantity, do you not think you would get a better serum?—Yes, with a larger quantity we could get a more active serum, because there would be a greater reaction.

(Witness withdrew.)

Lieutenant-Colonel Wilkins, I.M.S., called and examined.

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410. (*The President.*)—I believe you are in the Indian Medical Service and are now acting as Special Medical Officer in Bombay?—Yes. I am in charge of the hospitals and camps.

411. I think you can give us some information as to the several steps which have been taken in Bombay to counteract the progress of the plague?—I can tell you what has been done in my own wards. I was first in charge of "B" Ward, Bombay; and within the last two months I have been placed in charge of the Plague Hospitals and camps.

412. Perhaps you will tell us the different arrangements which have been made to meet the epidemic?—The arrangements are different now from what they were a short time ago. Before the riots we had search parties and took the cases out.

413. The city, I suppose, is divided into a certain number of wards?—Yes.

414. Can you tell us how many?—Seven.

415. I understand you were in charge of one of them; what are you in charge of now?—I am in charge of all the Plague Hospitals, public and private, and I am also in charge of the camps.

416. Will you give us some information about the ward you were in charge of during the earlier part of the epidemic, and what arrangements were adopted there?—I had a large Medical Staff under me, as well as a Military, and we divided off my ward into so many sub-sections. The Medical Officers were placed in charge of these, and also the Military Officers. Search parties were sent out every morning and every evening to collect as many cases as they could, and those cases were sent to hospital. In some instances, we sent the contacts away to camp. In some cases, we evacuated the bad houses and chawls and disinfected them thoroughly. That is practically the work we did.

417. First with regard to the hospitals: about how many are there in Bombay?—There are 32 hospitals and camps. There are about six camps, and the rest are hospitals.

418. Twenty-six hospitals and six camps?—Yes.

419. I suppose the accommodation in these hospitals varies considerably?—Yes.

420. Within what limits?—From 15. I do not know exactly what is the accommodation of the Arthur Road Hospital, but I should think a hundred and fifty.

421. Are they small hospitals?—The Arthur Road Hospital is a large hospital. I am not quite sure of the number of patients it can accommodate, but I should think it is about 150.

422. Is the provision thus made ample for the requirements?—At present we could put up a thousand cases.

423. And you consider that quite sufficient?—At present.

424. Will you kindly tell me the organisation of an average hospital?—We have a Medical Officer in charge, not necessarily a Resident Medical Officer; a House Surgeon, who is resident; and in some of the largest hospitals, we have European nurses; and we have a staff of ward orderlies, and ayahs for the women; and all the necessary staff in connection with a hospital.

425. There is a sufficient nursing staff?—Yes, I think so.

426. Could you increase it?—Yes. If we wanted it, we could always increase it at any time.

427. I suppose the nursing has always been carried on well at night as well as during the day?—Yes, I have reason to believe so.

428. In the largest hospital is there any Superintendent, apart from the Chief Medical Officer of the hospital; is there any person who is responsible for the administration, or who directs and takes charge of the nursing?—That is all under the Medical Officer. He makes his own arrangements. I visit the hospitals, and if I see anything I wish to call attention to I immediately do so.

429. Do you find much improvement in the condition of the patients after their removal to these hospitals?—Most decidedly.

430. Can you give us the mortality of those who are treated in the hospitals?—I cannot.

431. Do you know if the mortality is greatly below what it is when the patients are treated in their own houses?—I cannot tell.

432. What is the treatment?—Cleanliness, good food, good nourishment, and all that care can do for the cases. I do not think we can pin our faith upon any medicines for plague, except heart stimulants in cases of collapse, and ordinary stimulants like wine and brandy.

433. There is a great tendency to cardiac failure?—That is one of the greatest dangers. The pulse fails.

434. But all the medicinal treatment you have employed has not affected the mortality?—I should say not.

435. Have you had any experience of treatment by curative serums?—Not personally; but Professors Yersin and Simond were both up in Cutch Mandvi during the heavy epidemic, and they tried their serum there. This is the last report which I think explains the whole of their results.* I should like to hand it over to you.

436. (*Mr. Hewett.*)—Who is this written by?—Dr. Simond of the Pasteur Institute. He is away now. It was a paper read before our Medical and Physical Society.

437. (*The President.*)—The whole of your information is contained in that report?—Yes; more or less.

438. You have not directed this serum to be employed in

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* See Appendix No. VII in this Volume.

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any hospitals under your supervision?—No; they took any cases they wanted.

439. In Bombay?—This serum was used in our hospitals at Cutch Mandvi and not so much under me in Bombay.

440. Have you formed any opinion as to how plague came to Bombay?—No; I have nothing to say upon that.

441. Or how it came to India?—No.

442. What is your notion about it being endemic in some parts of India?—I have heard of its being endemic in some parts of the Himalayas.

443. Do you know that of your own knowledge?—No; it is merely hearsay.

444. (*Mr. Hewett.*)—Have you found that the people go much more readily to the hospital than they used to?—Yes.

445. I suppose that the fact that patients have come too late to hospital may account for the high proportion of deaths?—Undoubtedly to some extent.

446. Have you had any experience of the treatment of Europeans?—No.

447. Can you say approximately how many persons are sent to the segregation camp in Bombay daily?—Impossible to say as the number varies very much.

448. Within certain limits there are not very many cases a day, are there?—Very few, comparatively, now.

449. What is the maximum you can take into the segregation camps?—5,000 or 6,000 persons.

450. Can you increase that number?—Yes, we could increase it much more than that.

451. Could you increase it to 30,000?—I could not tell you.

452. To 20,000?—It depends upon the area taken up. There is a fairly large area.

453. You can not say more than that you can increase it substantially?—It can be substantially increased.

454. I should like to ask you about your experience in Cutch Mandvi. When did you go there?—I was sent there at the end of April 1897.

455. When did cases of plague begin to occur in Mandvi?—As far as I could trace it the cases began about February.

456. Plague had been going on for more than two months before you got there?—Yes.

457. Was it very virulent?—Yes. It was very virulent.

458. It was about the most virulent attack you had in the Bombay Presidency?—I should think it was one of the most virulent.

459. Have you any idea as to how it got there?—As far as I could trace its history it was imported from Karachi.

460. What did you base that opinion upon?—Public opinion, from traders.

461. Is Cutch Mandvi a large city?—Yes. Cutch Mandvi does a large trade along the Bombay coast, and as far as Zanzibar.

462. And there is a good deal of trade with Bombay, is there not?—Yes.

463. Is it not possible that plague came from Bombay?—It is possible. But as far as I could sift the evidence, general opinion seems to be that the first case came from Karachi.

464. It is a difficult thing to come to a conclusion upon?—Yes.

465. What measures did you take at Mandvi?—I erected hospitals; got coolies from Bombay; evacuated the town as well as I could; and cleansed the whole place from top to bottom.

466. Did you have much difficulty in getting the people to evacuate their houses?—No; they were too much cowed.

467. Did you find it easy to get them to go into segregation camps?—That was the difficulty. I found it difficult to get them to go into segregation camps built for them. They were willing to go outside and build themselves shanties.

468. Where they would be out of all control?—They were practically within a mile or two of Mandvi, so that one could visit the place. I used to go round.

469. But you had no security that they remained in those places?—No.

470. I suppose as a matter of fact they were constantly leaving?—Yes; and they spread plague all over the place.

471. The people were being constantly joined by other people?—Yes.

472. Did any portion of the population go into the segregation camp?—Yes.

473. Who?—The Borahs. They built a segregation camp outside the city and they suffered least of all.

474. How many Borahs went into the segregation camp?—Approximately 6,000.

475. Can you tell me the extent to which plague attacked them after they had gone into the segregation camp?—I cannot tell you.

476. Can you give us any figures to show how far they secured comparative immunity?—Great numbers of them were injected with 10 c.c. of Yersin's curative serum; and not one of them that was injected got the plague.

477. (*The President.*)—How many were injected?—This is Dr. Mason's report.* He had charge of the hospitals and was working under me. He says: "It has not been found possible to inoculate whole communities every 10 days. The communities object, in which case it is not accurate to ascribe the absence of plague to the immunising effect of the serum." We came to the conclusion that the good from the injection did not last more than 10 or 11 days. "Nevertheless it is an extraordinary fact that out of 721 persons who have been inoculated once only up to the present, not a single case of plague has developed. These cases have all been registered, and are composed of different castes, living in different places; men of the Borah community 380; children of the Borah community 191; men, women and children of Muska village, 110; men, women and children of Bada village, 16 miles from Mandvi, 140."

478. (*Mr. Hewett.*)—Were there segregation camps in those two villages?—Yes.

479. You had plague cases occurring in those two villages?—Yes.

480. But the people who had been inoculated escaped?—Yes. 150 people were inoculated.

481. (*Dr. Ruffer.*)—Inoculated by Yersin's serum?—Yes.

482. (*Mr. Cumine.*)—Were they inoculated after they had gone out of the towns?—Yes.

483. Or, whilst they remained in the town?—Most of them were inoculated in the camp outside.

484. (*Prof. Wright.*)—Judging by the rest of the community would you naturally expect many of them to get the plague?—Yes.

485. (*Mr. Hewett.*)—Have you any record of the number of cases which took place in the Borah segregation camp, for instance?—No; unfortunately I have not.

486. Is it the case that the plague has always attacked Cutch whenever it has been about the Bombay Presidency?—I have not followed the history of the plague very accurately there; but I do not think they have had an epidemic since.

487. (*Dr. Ruffer.*)—You have referred to search parties in plague infected districts. Did you find much resistance to those search parties? In Bombay generally what is your experience?—They do not like them.

488. Do you find that cases are hidden?—There is not the slightest doubt about it.

489. Do you think that when a search party comes into a district cases may be carried from that district into another district which is not yet infected?—I am perfectly sure of it. They are concealed and carried away.

490. In your evidence you spoke of the segregation of "contacts." Would you tell me what in your opinion is a "contact"?—A "contact" is a person attending upon a sick man. There is a great deal of communication between native people.

491. A person in actual communication, living in the same room?—Yes, or in the next rooms. There are a series of rooms. I should say the next rooms.

492. When you found a case of plague in a house, how many people did you send to the segregation camp on an average?—It varied.

493. What would be the average number of people: would it be four or a dozen?—Seven or eight. It would entirely depend upon the condition of the house. In a very badly infected chawl we should probably evacuate the whole place.

494. Do you think a great many contacts escaped?—Yes.

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* See Appendix No. VIII in this Volume.

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495. Do you think that the majority escaped?—I know that when they got wind of the fact that we took away the contacts they scattered.

496. At the present moment what are the rules of the segregation camp as applied in Bombay? Has a man, for instance, going into a segregation camp to stay there all day?—He is allowed to do exactly what he likes, as long as he comes back at night and sleeps there: he is allowed to go to his work; he is a free man.

497. As a matter of fact, do they all come back, or do you find that a certain number do not return?—Very few do not return. It is quite an occasional case for a man to go out and not to come back again.

498. When a segregated patient gets plague, does he go back to the camp, or does he go and hide himself?—I know that we have taken out cases from these segregated people,—contact people,—and sent them to hospital.

499. Have you any evidence of a man being segregated, going out to his work, getting plague and not coming back to camp—going and hiding himself?—I have no evidence of that.

500. What is the proportion of people segregated that get plague,—of course excluding the instance you referred to just now where people were inoculated? Out of a thousand people segregated in a camp, how many would get plague; a certain number do get plague?—A very few, I should say.

501. Could you prepare some statistics with regard to the segregation camps?—Yes. And you want to know how many cases we have had in the camps from the people that have been segregated.

502. That is exactly what I want to know?—Very well.

503. I should like all the evidence that you can bring upon this point for a short period, say, a couple of months—the time that elapses between the attack, and the time they were segregated?—I will give you that.*

504. In your opinion how does one plague patient infect the other?—In pneumonia there is the breath and the sputum.

505. Do you think, for instance, that an ordinary bubonic case is dangerous to his fellowmen around him?—I should say he was. I cannot tell you exactly why, except that numbers of cases have happened amongst people in chawls. The surmises are that they infect each other.

506. You do not think they may all have been infected from the same case?—A pneumonia patient.

507. Do you know of a bubonic case that has certainly infected another case?—I cannot call to mind one.

508. But you have plenty of instances where pneumonic cases infected other cases?—Yes.

509. I see in your evidence that you spoke of a form of plague which is called acute plague, dysentery,—is that a recognised form of plague?—They get it in the later stages of the disease. The mesenteric glands are affected.

510. Could you give us a short account of the pathological appearance?—No. I made no *post mortem* examinations.

511. What are the clinical symptoms?—The acute cases turn into acute dysentery and the people die after being so many days in hospital, practically going through a case of plague, eventually getting dysentery and dying.

512. Do you find the plague bacillus in the evacuations?—I do not know.

513. Can you feel the buboes, either internally or externally?—No.

514. The only reason for believing in this form of disease is the fact of people coming from infected places, or people who have been in contact with plague patients getting dysentery?—Plague patients themselves get it.

515. Then you mean to say it is dysentery occurring in a plague patient?—Yes.

516. Have you any evidence as to the dissemination of plague by rats?—No, except that dead rats have been found prior to an outbreak of plague in a certain locality.

517. Have you any evidence that plague occurred in a certain village, without a contaminated patient ever coming into the village?—I have no evidence of that.

518. You have no evidence absolutely proving that a man can be inoculated from rats?—I can give you no definite evidence upon that point.

519. Or evidence of people being contaminated by fleas or mosquitos?—No.

520. Have you any evidence of Haffkine's inoculations?—None whatever.

521. (*Mr. Cumine.*)—You are Medical Officer in charge of all the hospitals and camps?—Yes.

522. Before you were appointed to that duty the Plague Committee supervised all the hospitals and camps?—Yes.

523. I think there was a Medical Officer on that Committee?—Yes. Colonel Hay at one time, and Major Dimmock.

524. At any rate the hospitals and camps were not left without any supervision?—They were all supervised.

525. And before the days of the Plague Committee there was the Municipal Commissioner?—General Gatacre was the Plague Head.

526. Before him there was the Municipal Commissioner and the Health Officer?—I believe so. I was not under them at all.

527. Before that, of course, there were no Plague Hospitals at all?—No.

528. You mentioned certain modifications introduced after the riots, but I think they had been determined upon by the Government before the riots, had they not?—I could not tell you. They came into force afterwards.

529. When women and children get bubonic plague, have you noticed that they often have the bubo in the neck?—That has not struck me as being the case.

530. Have you anything to show that plague goes from one man's house, to the house of a relation,—that it appears to be carried by relations?—Yes. I think that was proved at the out-break in Cutch Mandvi. I will read this† :—"A woman and her child, passengers from Karachi who were affected with plague, were in the camp near Muska, and this woman who from the symptoms apparently suffered from pneumonic plague was nursed by her sister-in-law a resident of Muska; the woman died and her attendant went back to the village and died of the disease, and ten others also." So that it can be communicated from one place to the other.

531. Have you any reason to suppose that in a general way it is carried by the friends and relations of a sick person coming and sitting beside him and then going back to their houses, and contracting the disease?—That is a very difficult question to answer.

532. Natives habitually go about with bare feet, do they not?—Yes.

533. Are there not constantly cracks on their feet?—Very often.

534. Do you think there are more cracks on their feet than on their hands?—Yes. Out of 250 cases dying with buboes it was found that 60 had the right inguinal region affected, and 58 the left: showing that the probabilities are that the feet were affected; and from the left and right axillary there was only a very small proportion.

535. As a matter of your own observation, are there not oftener cracks in a native's foot than in his hands?—Yes.

536. Do not natives suffer a great deal from skin disease, itch and ring-worm and such things, which they scratch?—Yes, very much.

537. Have you noticed in Mandvi that one sex has the plague more than the other?—The deaths from all hospitals in Mandvi were as follows.

Males	1,226
Females	1,727
Children	563

538. Is it within your knowledge that in castes, where men are out all night,—fishermen, for instance,—the women get plague oftener than the men, as though night were the time when people get the plague?—I could not tell you. I have no statistics to prove it.

539. When the Mandvi people went out and lived in their own huts, a great many of them, you say, escaped?—Yes.

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* The witness was unable to supply figures as required.

† See Appendix No. VIII in this Volume.

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540. Why should they have gone away ?—They ran away from the disease. About 40,000 people lived in the city, which was a mile square, before the severe epidemic. They were naturally frightened of the disease in such a boxed-in place and they all went out.

541. After they got out into the fields and built their own huts what further occasion was there for them to run away ?—The probabilities are that if there was a case in a hut they ran away from it. After going out they got frightened and they ran away to another place, probably to a village.

542. Did you succeed in organizing a scheme so that the people reported themselves ?—I got the heads of communities to help me as much as I could.

543. Did they do it themselves, without your going with them ?—The Borahs did.

544. It is possible, then, to get the heads of the communities to inspect the huts of their fellow caste men ?—They do it in a fashion.

545. But you do not think they do it effectively ?—I do not know.

546. Can you get them to move out infected persons 50 to 60 yards off ?—They build their huts, and have their cases removed there.

547. In Bombay the plague is at a low ebb just now, is it not ?—Yes.

548. October is a notoriously muggy and hot month, is it not ?—Yes.

549. The people sleep out a great deal ?—Yes.

550. When the cold weather begins they will be inside and shut up their windows ?—Yes.

551. Have you noticed that it has any effect upon the plague,—people sleeping inside with closed windows ?—A decided effect.

552. With regard to the removal of people to the hospitals, have you any idea during the worst period of the epidemic in Bombay, what the rate of mortality in the hospitals was ?—I could not tell you.

553. (*Prof. Wright.*)—Do the people object to inoculation by Yersin's system ?—The Borahs came up voluntarily.

554. Did any one suffer any ill consequences ?—In one case there was a little œdema of the part affected.

555. Was there not a considerable number of cases of that ?—They were the mildest. I was inoculated myself, and I experienced absolutely no inconvenience.

556. Are there cases of plague in Bombay now that the contacts are segregated ?—I cannot say. I have not been doing any of that work. It would be only hearsay evidence that I could give you, and that would not be much.

557. How is a plague patient disinfected before he leaves the hospital ?—He gets a thorough disinfecting bath, and a new suit of clothes.

558. Is there one regulation for all hospitals ?—I fancy so.

559. (*Dr. Ruffer.*)—What is the disinfecting bath ?—Phenyle or carbolic acid.

560. How much per cent. ?—As long as they get a certain amount of smell from the bath, and know it is a phenyle bath, I do not think there is any particular strength used.

561. Are their clothes taken from them ?—Their clothes are burnt.

562. And they are started again in life with a new suit of clothes ?—Yes.

563. Are any disinfecting measures taken when a person goes into a segregation camp ?—I believe there are; but I am not in a position to tell you for certain. I have not gone into that. We have two steam disinfectors at work.

564. In the case of plague occurring in a segregation camp, what measures do you take for the people who are in contact with the plague ?—We have two camps, one is the segregation part, and the other is the contact part. The contacts are put on one side, and the people removed from the houses are put on the other.

565. They are passed on ?—Yes.

566. (*Mr. Hewett.*)—In reply to Dr. Ruffer you said that the people in the segregation camps in Bombay itself are now allowed to go out on detailed duty : that was not the case with the Borahs in the segregation camp at Mandvi ?—Their work lay in the city, in the infected part. They were merely asked to go out. They built themselves very nice comfortable quarters.

567. Moving in and out just as they liked ?—Yes ; we had no control over them.

568. (*Dr. Ruffer.*)—Were they allowed to go into their own houses ?—They were shopkeepers, but trade was practically at a standstill. There was, however, a certain amount of trade going on. The Borahs are great tradesmen.

569. (*Mr. Cumine.*)—Have you any experience with regard to the value of perchloride of mercury as a disinfectant ? Do the people get the plague after you have disinfected a plague-stricken room, or do they not ?—I have no experience.

570. (*The President.*)—You never trust to perchloride alone ?—We used hot lime: 5 ounces of carbolic acid in half a tub of liquid lime.

571. (*Dr. Ruffer.*)—How much is half a tub ?—Half a cask.

572. (*Mr. Cumine.*)—Is it your experience that people can be safely put back again into a plague-stricken room after that disinfecting operation has been performed, or is it your experience that it is not safe to put them back ?—To be on the safe side I should say keep them outside as long as possible. I would not put them back sooner than I could possibly help.

573. Have you anything to show that if they are not kept upon the safe side, and are put back, they get plague ?—I do not know.

574. (*The President.*)—As a matter of practice how long do you keep them out of their houses after they have been cleaned ?—I disinfected a place called Nowroji Hill in Bombay (a very insanitary place) and we kept them out as long as a month, until we disinfected their houses, and had proper ventilation put up for them. We have holes cut between each floor and give them ventilation, and let the air pass right through the house.

575. Do you know what opinion is held as to the minimum time a house ought to remain unoccupied ?—No.

576. Sometimes they return much sooner than at other times ?—We can lay down no hard and fast rule. It entirely depends upon circumstances. In some instances you have to send in the people sooner than in others.

577. Have they sometimes been sent in too soon, judging from the reappearance of plague among them ?—I do not remember. I think some of the District Officers would be able to give you information about that.

(Witness withdrew.)

Mr. A. G. Viegas called and examined.

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578. (*The President.*)—I understand you are in private practice in Bombay ?—Yes.

579. You are able to speak about the first cases of plague which occurred in Bombay ?—Yes. I saw the first case on the 18th of September 1896. It was the case of a woman. When I went to see her I was struck by the peculiarities which I found in the case, specially the physiognomy of the patient, and by the fact that her drowsiness was of a peculiar kind. She could be easily roused but she as easily relapsed into the drowsiness. When she attempted to answer a question she answered half a sentence or two, and then became drowsy again. Another peculiarity about the case was that her speech did not seem to be quite natural : it was quite thick. She faltered a great deal when she spoke, and even though her own relations explained to her the nature of the questions in her own language, she seemed not to understand the questions fully, or seemed to lose the train of her own thoughts whilst answering them. Another peculiarity which I noticed was a bubo. I believe it was in the left femoral region. I closely questioned her husband. I first of all observed if there was any cause for it, any cut or wound or sore at that extremity. I asked the husband if he had any venereal affection. I made as close an enquiry as I could, and I failed to elicit anything which could have caused the swelling in the left femoral region. Another peculiarity which I noticed in this case was the congested state of the conjunctivæ. They were almost blood-shot.

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There was nothing to explain that condition. There was no brain affection, or any proper conjunctivitis or any irritation to explain this blood-shot, highly congested condition of the conjunctivæ. I left the patient, having prescribed for her diaphoretics and quinine. I saw the patient about half past eleven in the morning and in the evening I got a report to say that she was better. At half past nine, however, it seems that she grew worse than she had been in the morning. Her relative who had taken me, hunted for me the whole night but could not find my house. Early the next morning, however, he found my house, and he hurried me on to the house of the patient; but by the time I got there she had died. Another peculiarity I observed in the case was this. I saw this woman only the previous morning, and she did not seem to be so seriously ill. I was surprised to hear that she had died. The rapidity of the course of the disease, and the fatal termination both struck me.

580. That was the first case you saw?—Yes. Then on the same day another patient came to my dispensary in a carriage, and I thought I saw the same special physiognomy in this case. He was a young man of about 18 or 20 years of age. He came out of the carriage unsupported. I thought his temperature was about 104°. I tried to find if he had any swollen gland. Suspicion was aroused in my mind with regard to the first case, it being peculiar, and I thought possibly that it might have been a case of plague. In this case I could not find any bubo. I told the relative who came with the patient to come again in the evening and let me know should he develop any swelling. I told him the places where to look for the swelling. The next morning the patient was unable to come to my dispensary, and I was sent for. The messenger informed me that a swelling had appeared. I explained to the patient's uncle, who is a very intelligent and well-educated man, that I suspected that this might be a case of plague, but that I could not say for certain. I told him why I suspected it. I gave him the particulars of the case I had seen before, and that I had asked his man to look for a swelling, that the swelling had appeared, and that I thought very seriously of the case. The patient's uncle informed me that about 50 or 60 persons had died in the locality of his residence rather suddenly. That made me suspect the nature of the case still more. I expressed to the uncle my desire of showing the case to an older practitioner. I mentioned the name of Dr. Blaney, who is one of the oldest practitioners in this city, but as it happened to be Sunday, and as a few days before Dr. Blaney had expressed a reluctance to go out on Sundays, I called in another friend of mine, Dr. Cowasji Pestonji. We drove together to the house and I told him that I was going to show him what I suspected to be a case of plague, at which he expressed his surprise. We saw the patient together. The young man's temperature was 104°. He was restless. He had already been branded at the swelling by his uncle. It seems that they thought the branding did good. We saw the case and I told the uncle I was still anxious to show the case to Dr. Blaney. I added that should the patient survive the night he was to send me his carriage in order that I might fetch Dr. Blaney the next morning. Dr. Cowasji Pestonji was surprised at my thinking that the patient would die during the night; but I had had the sad experience of the first case, and I ventured to tell him so. I also asked Dr. Pestonji to send his nephew, Dr. Surveyor, who is a very highly qualified bacteriologist, to me the next morning, as I wished to make a bacteriological examination of the blood as well as of the serum from the branded bubo, and also of the urine, so far as it could be had. When I got to my dispensary at about half past eleven, I heard that the patient had died. Dr. Surveyor came that morning as requested, but before he came, I was called to see a third case below the bridge on the Port Trust Estate. This also was the case of a woman and I found almost similar symptoms. I took Dr. Surveyor to this third case, and he got some blood from the end of a finger, and also some serum from the branded bubo,—so far as I can remember, the bubo had been branded. I also got some urine, and gave it to Dr. Surveyor for examination. He then and there prepared some slides for the microscope. I believe a meeting of the Standing Committee of the Corporation was to be held on the 23rd of September, and I gave notice of motion, expressing my belief that the plague had appeared in the city. After seeing the second case, I wrote to the Municipal Commissioner and to the Health Officer expressing that belief. They however were not in the city—it was Sunday. I went to try and find them, but could not do so. The discussion came on in the Standing Committee on the 23rd September 1896.

581. Where did these cases occur?—The first case I saw was in Vor Gaddi, Samuel Street.

582. Where is that?—It is a part of the Mandvi Ward. The second and third cases were on the Port Trust Estate, in the same Ward.

583. What was the result of the bacteriological examination you have referred to?—Before I went to the meeting of the Standing Committee, I called at the laboratory of the Grant Medical College to see the results of these examinations.

584. What did you find?—I found some bacilli, but I could not quite reconcile them with those shown in a plate in an article which appeared in the *Lancet.* They looked something like it, however; and I thought they were plague bacilli. At the meeting of the Standing Committee I mentioned the fact that I had seen them.

585. How soon after these cases were noticed was the plague bacillus first definitely identified with cases of plague in Bombay?—I cannot say whether the bacilli that were shown to me were the exact bacilli. The specimens I saw afterwards seemed to differ a little from the one I saw at Dr. Surveyor's laboratory.

586. You referred them to Dr. Surveyor as an expert?—Yes.

587. What was Dr. Surveyor's opinion?—He said he found the bacilli.

588. You have referred to some 50 or 60 other cases which were said to have occurred about the same time or even before the first cases you saw?—Yes. Fifty or 60 persons died, but I did not see them.

589. Did you hear in what Ward the cases had occurred?—Yes, the same Ward, and on the Port Trust Estate.

590. After your suspicion had been aroused with regard to the two cases you saw, did you make enquiries into the history of the cases?—No sooner did I suspect the nature of the case than I made enquiries. I found they had not been out of Bombay at all for some time.

591. How long?—For a month.

592. What was their social position: what were they?—The first patient was the wife of a Banniah. He was not well-off. The second person was in very good circumstances. He was the nephew of a merchant. The third was the wife of a labourer.

593. Is there any law requiring you to notify infectious diseases in Bombay?—Yes.

594. Within what time must you notify?—As early as possible.

595. Did the City officials visit the place and make any enquiries into the matter as far as you know?—So far as I can speak of this matter, I think enquiries were made after the discussion took place. It was after the meeting of the Standing Committee on the 23rd of September.

596. When did you report?—I reported the case on the 19th, that was on a Sunday. The letters were sent on the next day, that is, the 20th of September.

597. (*Mr. Hewett.*)—You say that you had heard that none of these people had moved out of Bombay: do you know whether any outsiders from any other part of India had been in that quarter?—I do not know.

598. (*Dr. Ruffer.*)—When you discovered the first case, it had not been suggested to you by anybody that plague was actually in Bombay?—No.

599. It was an entirely original diagnosis on your part?—Yes.

600. At that time had you heard of any special mortality among rats?—No.

601. When was the first you heard of mortality among rats in Bombay?—I heard it first at the meeting of the Standing Committee. One of the members, Mr. K. M. Shroff, at the same meeting said he had been informed that rats had been dying in large numbers in this Ward on the Port Trust Estate, in the Mandvi Ward.

602. Had the mortality in that Ward been very much higher than in other Wards?—I could not say that.

603. (*Mr. Cumine.*)—Is not Mandvi the Customs Bandar at Bombay?—Yes.

604. The quays are there, where the ships are laden?—The Docks are there.

605. Is not there a large collection of grain there in the export season?—Yes.

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606. So that you would expect more rats to be there than elsewhere?—Yes.

607. Is not Mandvi the place where the plague always hangs about in Bombay?—Since its appearance in 1896.

608. You mean that that is the one spot in Bombay where, if there is plague at all, it is sure to be?—It sticks just there.

609. Had you heard anything of some cases of plague having occurred in Byculla as early as March in 1896?—No; but after my cases were made known I read or heard that one or two practitioners were saying that the disease had been seen in Byculla or some other place.

610. Who were the practitioners?—I did hear, but I do not remember their names. I did not then and do not now think that they were cases of the plague.

611. As there had been 60 or 70 cases when you discovered the plague, how long do you think it had been in Bombay?—It might have been a month before.

612. You think that if it had been there a month it would have produced 60 or 70 cases by the time you found it out?—It is a statement made by a third person: I could not verify or vouch for it. If the statement is true I do not think it could be earlier than a month, because I found that the spread of the disease in Mandvi itself was not very fast. I think that the cases which appeared in the other parts of the City were mostly those which were removed from Mandvi proper. I think that was the way the infection was originally spread.

613. (*Prof. Wright.*)—Have you ever found any buboes without serious symptoms? Have you been accustomed to find buboes other than venereal?—Sympathetic, if there is any cut, specially on the feet of those who go barefooted.

614. Are they rarities, or are they common in your practice?—They are not uncommon. I do sometimes see sympathetic buboes from cuts, boils and other things, but they are not attended with such serious symptoms as I saw in the first cases. The people go about and do their ordinary business: they are generally poor people.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Secretariat, Bombay.

FOURTH DAY.

Friday, 2nd December 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D. F.R.S. (PRESIDENT).

MEMBERS.

MR. J. P. HEWETT.

PROF. A. E. WRIGHT, M.D.

MR. A. CUMINE.

DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

MR. F. M. GIBSON called and examined.

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615. (*The President.*)—I believe you are a Bachelor of Medicine and a Bachelor of Science in Public Health?—Yes and also in the Department of the Experimental Sciences.

616. I think you have come to India specially to enquire into questions relative to the plague?—I have.

617. How long have you been engaged in this work?—Fourteen months.

618. Are you in a position to tell us the nature of the investigations which you have carried on?—Yes.

619. I should be very pleased if you will do so in your own way?—I propose to give a description of the experiments I have carried out under the direction of M. Haffkine. I have attempted to find the plague bacillus in nature, that is to say, outside the animal body. I have examined some fifty samples of different materials in Karachi and in Bombay. The samples examined in Karachi were done in the months from June to September this year. I prefer to take first into consideration the samples which were done since September in Bombay. The reason for that is that in Bombay parallel experiments were carried out with the same material before and after it had been infected with plague, and that the results obtained show the rat to be a sensitive subject for such experiments. I examined eighteen such samples in Bombay and failed to isolate plague from any of them.

620. Samples of what?—Sixteen were soils from infected dwellings; two were samples of wearing apparel from plague-stricken people. They came from various towns in India. Five were collected in Bombay, six from Dharwar, and seven from Hyderabad (Deccan). The samples were examined by ordinary cultivation methods and by inoculation into rats.

621. Where were the samples collected from?—The samples were collected from the floors and walls of dwelling-places in which cases of plague had recently occurred.

622. What do you mean by "recently"?—Within two or three days. A small portion of the sample was suspended in sterile broth, and tubes were cultivated from the resulting suspension. One c.c. was injected subcutaneously into a rat. The rats were obtained from shipboard—from ships in the harbour—and they were kept under observation for some ten days before the experiments were carried out. In no case did I succeed in finding any trace of plague by cultivation.

623. (*Prof. Wright.*)—You took earth, and you infused it with sterile broth: did you filter that broth off afterwards?—I allowed it to settle, and took the somewhat turbid suspension.

624. Did you inoculate that?—Yes; I inoculated agar tubes.

625. How much of the infusion did you put on: did you swamp the surface with it?—I smeared the surface of four agar tubes with one small drop: I adopted no means of measuring the amount. One c.c. of suspension was injected into each rat.

626. Was that which was injected into the rats taken from the agar tube or taken from the broth from which the agar tube was inoculated?—It was the broth containing the finer particles of soil in suspension and from which the agar tubes were inoculated.

627. (*The President.*)—There were two experiments, one was injection, and the other was cultivation?—Yes. Out of the eighteen rats, two died; but I failed, on dissecting the rats, to find any sign of plague in the organs. The parallel experiments were made with the same suspension, a portion of which I had injected into the other rats, and a trace of a culture of plague was added to it.

628. In saying "suspension," you mean suspension in which the same solid was used?—The remaining portion of the same suspension.

629. Earth also?—Earth also, in sixteen cases. A trace of plague was in all cases added to the suspension. Agar tubes were inoculated and each rat received one c.c. of the suspension by subcutaneous injection. In two cases only was I able to isolate the plague from this mixture by cultivation.

630. In the previous case you did not find it at all?—I failed to find it. The amount of plague added was very small, and in two cases only was I able to isolate plague by

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cultivation. Sixteen of the inoculated rats, which received this mixture of plague and soil, died; in 12 of these I recovered the plague bacillus in pure culture.

631. Did you make any experiments with this mixture *minus* the plague bacillus?—The previous experiments I have been talking about.

632. Not from plague-infected dwellings, but from earth obtained otherwise under the same conditions as in the case of the last experiment you are speaking of?—No, I have not made any such experiments.

633. Is it not possible that this earth itself without the plague bacillus might have produced death in the rats?—It did in two of the previous cases,—in two out of 18 cases. The points I wish to specially emphasize are that I failed to isolate the plague in any of the pure samples. I never succeeded in isolating the plague from unmixed samples—the samples to which no plague had been added. The amount of plague added in the control experiments was exceedingly minute, and in two cases only was I able to detect it by cultivation, but in twelve the rat seemed capable of selecting the plague germ from the mixture, and I recovered the germ in pure cultivation from the tissues of the rat.

634. (*Prof. Wright.*)—How did you measure the quantity of plague which you put into the earth extract?—I did not measure it in any way exactly. I did it in this way. I took an agar growth—a growth of plague bacillus on agar—two days old, and by means of sterilised water I detached the growth as completely as possible, repeating the process of washing with sterilized water until the water was no longer turbid. The water was perfectly clear, and nothing could be detected as growing upon the surface of the agar. Into this tube I poured about 5 c.c. of my soil suspension—soil suspended in broth—shook that up, and injected 1 c.c. into the rats. The amount added could not possibly have exceeded one-thousandth part of an ordinary culture on agar tubes. I now turn to the experiments in the materials examined in Karachi. I examined 30 samples of different materials in Karachi.

635. When was that?—Between June and September 1898. Ten of these were soils from infected dwellings, and mercantile stores—godowns. Ten were samples of gunny-bags—jute bags used for storing grain and other merchandise. Five were samples of grain itself; and three, dead rats found in buildings supposed to be infected; and two, samples of ants. These were examined by cultivation and injection into rats, in a very similar manner to the Bombay samples, but I did not infect the material with plague and carry out a parallel series of experiments. In these thirty samples I never once succeeded in finding the plague bacillus. The next series of experiments in Karachi I carried out with a view to infecting rats with plague by exposing them to a material from infected localities. These experiments were done with a view to throwing some light on the origin of the second outbreak in Karachi—the outbreak of this spring—which had been attributed to merchandise imported from Bombay. I examined these samples of bags and soil in Karachi as I have already described, and having failed by inoculation or by cultivation to find the plague bacillus, I fed the rats for a period of ten days or a fortnight on corn which had been wrapped up in these gunny bags. The outbreak at Karachi had been attributed to several cargoes of gunny bags brought from Bombay. The rats did not develop plague by being fed on such gunny bags. I may mention that the corn was wrapped up in gunny bags and wired round, so that the rat had to gnaw its way through the bag. It could not undo the fastenings and it had actually to eat through the bag to obtain the grain. Having failed to give these rats plague in that way, I subjected the same ten rats to a diet of similar bundles of corn which had been thoroughly soaked in a broth cultivation of plague. The rat was starved for some 24 hours before the infected bag was given to it. The bag was fastened up in a precisely similar manner, so that the rat had to gnaw its way through the bag which was infected by pouring the broth culture of plague on and into it. This treatment of feeding the rats was continued for about a fortnight.

636. (*The President.*)—The corn was not infected; the bag only?—The corn was infected also. Each rat during the process of the treatment would receive about three of these little packages of infected material. At the same time as I infected the material, and in order to prove the virulence of the broth culture used, I injected control rats with the latter. All the control rats so injected died in about 36 hours.

637. How much plague culture did you inject?—About 1 c.c.

638. (*Prof. Wright.*)—One c. c. of a broth culture?—Yes.

639. How many c.c. of this culture had been used for infecting the corn?—About 50 c.c.

640. Fifty c.c. for each bag?—Yes.

641. And the rat ate the whole of one bag in the course of the day?—Very often; and burrowed out sufficient material to make itself a nest out of the infected bag.

642. (*The President.*)—Each rat therefore ate infected corn, and bags; how many?—Two or three bags. None of these ten rats developed the plague. Subsequently all ten were injected with a virulent culture of plague, and succumbed in about 36 hours. I did that to prove that they were not in any way immune.

643. They got, by subcutaneous injection, 1 c.c. of virulent culture; how many c.c. of that culture would they eat in the food they got?—From 100 to 150 c.c.

644. (*Dr. Ruffer.*)—Was the grain given moist or dry?—The grain was given moist. The rats were starved for 24 hours before the infected material was given to them.

645. (*The President.*)—Have you made any further experiments?—These are all the experiments up to the present.

646. Have they been negative?—Yes, as regards finding plague organisms in uninfected material.

647. With regard to the first series, you collected earth from the floor of the huts which for two or three days had been occupied by plague-stricken patients?—That is the case with regard to the Bombay samples.

648. You also took something from the walls, I understand?—Some of the samples were scrapings from the walls.

649. In the case of any one hut, did you take merely one sample, or did you take a number of samples from different parts of that hut?—The samples I collected myself in Bombay were only three, each sample being compounded of matter collected from different parts of a particular room; I could not say exactly how the others were collected.

650. So far as you know, each sample represents one hut?—Yes, one hut only.

651. Is it not conceivable that a hut may contain in its soil or in its walls a dangerous quantity of plague bacilli, and that these bacilli may not be evenly diffused on the surface of the soil of the hut?—Certainly, I think so; I have no information as to how most of the samples were collected.

652. What was the quantity of the sample you put into the broth tube each time when you made your emulsion?—About 1 gram. In Karachi I put much more than that.

653. What was the maximum you used?—I did not measure it accurately. I should say 50 grammes in 100 c.c. of sterilised water.

654. Did you take the sample indifferently from anywhere about the hut?—I collected the samples in that way.

655. Anywhere about the hut?—Yes.

656. Did you not select the locality where a case of plague had been lying in the hut?—I endeavoured to collect a portion of the sample in that way: close to where the patient was lying.

657. The amount you put in the broth tube you say was 1 gram?—Yes.

658. (*Mr. Cumine.*)—Did you collect the scrapings from one spot on the floor, or some from here and some from there, all over the room?—I collected them from scattered portions of the floor.

659. From how many points in the floor did you take scrapings,—from 4, 10, 15, or what?—Generally from five or six.

660. (*The President.*)—I quite misunderstood you. I thought you told me that you took one sample from each hut?—I drew your attention to the fact that I had not collected these samples myself. Most of the samples were not collected by me personally. Those I did collect, I took from different parts of the room,—suspicious parts, as far as I could judge.

661. Have you details of the number of samples that you took, and of the number of the huts?—I collected three samples myself in Bombay.

662. How many huts are represented in these three samples?—The three samples were taken from three huts.

663. That is, one from each hut?—Yes. I took the samples from five or six parts of the floor.

664. (*Mr. Cumine.*)—Did you take a note of the houses from which you took the samples: could you show the houses to us?—Yes, I could.

665. Were they single-storied houses?—Double-storied houses: in fact, one was a three-storied house.

666. Do you remember from what floor the samples came in each case?—One from the second floor and two from the ground floor.

667. Was the floor a cow-dunged floor?—Yes, cow-dunged in all three cases.

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668. Cow-dung and mud?—Yes.

669. Did you find out the history of the rooms? How many cases had occurred in each room?—I could not get any information with regard to one of them. It seemed to me an interesting case, because it appeared in a pregnant woman who had aborted in the plague period, and the floor was described to me as having been soiled with the discharge.

670. But had more than one person been ill with plague in any one of these three rooms?—Yes, in the other two there had been cases of plague in all three epidemics.

671. In any one epidemic had there been more than one case in any one of these three rooms? A man might get plague out in the bazar and lie down on this floor and die. If somebody else then goes and sleeps upon that floor and apparently gets plague from the floor, it would be a much stronger case for believing the floor to be infected than if only one person came in and died. Was there any reason to suppose that two people had died one after another on this floor; or had there been only one case in this epidemic?—I could not say as to that; but I could find out.

672. Did you find out whether the people lay on the floor or on beds?—They lay on the floor.

673. What sort of plague was it: diarrhœa plague or bubonic?—It was the bubonic form in all three cases.

674. You collected the scrapings yourself?—Yes.

675. At what depth did you take them?—From the surface.

676. How deep?—About one-eighth of an inch from the surface, according to the hardness of the floor.

677. Were the rooms well lighted with large windows?—The rooms were very badly lighted. One had no window at all: and the other two had very small windows.

678. Were your experiments tried actually in the room, or did you carry off the samples to the laboratory?—I carried the samples to the laboratory, and examined them immediately.

679. Did you cover them from the light as you took them?—Yes.

680. The sun did not get at them, or the air?—No.

681. Did you try the experiment of tying up rats on the floor to see whether in time they would get plague?—No.

682. Has any one got plague in these rooms since?—I could not be certain.

683. In taking the scrapings from these rooms, did you try and ascertain as far as possible where the sick person had been lying, and did you take some of the scrapings from that spot?—Yes, and I paid special attention to the rat-holes. If there were any rat-holes about I took a portion of the samples from the mouths of the rat-holes.

684. What was about the interval between the patient having left the room and your taking the scrapings from each of these rooms? Did you take a note in each case?—Yes; I took a note. In two of the cases I got that information. One was the case of a woman. She died at 4 p. m. on the 1st of November, and I collected the sample on the morning of the next day. Another case was that of a man who died at 1 a. m., and I collected the samples the following morning at 11 o'clock.

685. The Municipality had not disinfected the room in the mean time?—By special request they had not disinfected the room.

686. In the matter of Karachi gunny-bags you added bacilli to the gunny-bags; but when you had added the bacilli to the gunny-bags, and before you shut up to the rats with the gunny-bags,—the moment before that,—are you sure that the bacilli were alive, or might they have died in the meantime?—They could not have died in the meantime.

687. Were the bags in which the rats were shut up kept in the light or in the dark?—In the dark.

688. The rats did not live on the bags independently on the stuff they themselves had eaten and pulled out to make nests with?—No.

689. (*Dr. Ruffer.*)—Did you try any other kinds of food contaminated with plague,—food, for instance, which would be likely to produce lesions of the mucous membrane?—No.

690. Grain is the only thing you have tried?—Yes; grain is the only thing I have tried.

691. (*The President.*)—Have you made any other experiments to show whether the bacilli given by the digestive canal will produce any symptoms of plague?—I have made no other experiments.

692. Do you know whether they will or will not?—I have seen experiments described in books which give contrary results to mine. It is stated that you can infect rats and other animals by feeding them on plague infected material, but I have not succeeded in doing so.

693. (*Dr. Ruffer.*)—You have never fed several rats on another rat which had died of the disease?—No.

694. I think that would be an experiment which would be interesting?—That is an experiment which I propose to carry out.

695. It would be interesting because rats feed on other dead rats: in fact they generally begin to eat the rat before it is quite dead. It would be interesting to have such an experiment made?—I have tried keeping healthy rats with inoculated rats, but I was only able to carry out two experiments.

696. (*Prof. Wright.*)—Do you mean here by "inoculated" protected rats or infected rats?—Infected rats. I had a cage of five rats, two of which were infected. Those two rats died, but the others remained healthy; I took out one of the three remaining rats and inoculated it. It died, but the other two remained healthy: they are alive now. The second experiment had the same result: it was quite similar. I have not however done enough in that line to justify any general conclusion.

697. I understand your experiments show that when you have a mixture of plague and other bacilli you are more likely to find the plague bacilli if you inject into a rat than if you make a cultivation?—Very much more likely.

698. Did you make any calculation as to the number of bacteria you added?—Under the actual conditions it is impossible to make such calculations effectively.

699. Do you know what the percentage of plague bacteria was to the other bacteria in the material which you inoculated into the rats?—No.

700. May the plague bacteria have constituted 50 per cent. of the total bacteria?—In that case I should have recovered it by cultivation.

701. What is the minimum ratio which the plague bacteria must bear to the other bacteria to allow of your recovering them by cultivation:—what percentage of plague bacilli must be in the mixture in order that you can recover it by cultivation?—I think I could recover 1 per cent.

702. Have you made any experiments on that subject?—I only judge from the appearance of the tubes,—the number of the plague colonies visible as compared with other colonies.

703. With reference to these other experiments with grain,—is it suggested that grain is dangerous to the people who eat it (because that is the point which is tested by your experiment) or is it suggested that grain may have spread the epidemic by inoculating the hands of the people?—The second.

704. Then have you done any experiments with regard to inoculating this infected grain subcutaneously into rats?—No.

705. Have you had any experience with regard to M. Haffkine's inoculations?—I have only had a very limited experience.

706. Have you performed any inoculations yourself?—I have done about 50 cases.

707. Have you seen any evil results follow?—No, no permanent evil.

708. But you have seen high fever?—I have seen high fever. I have seen fever up to 104 degrees.

709. (*The President*).—I do not quite understand the collection of your samples. Have you kept notes of what was done?—Yes.

710. You are still carrying on experiments?—Yes.

711. Could you give us some details of the series of experiments you have made? Perhaps you will write them out and send them in. We should like to know how many samples were examined, the result of the examination of each: in fact we should like to know actually what the sample meant: whether it represented one scraping or several scrapings, from what part of the room, the relation of the room to the infected, when last infected, and how many people were infected in the room. Could you give us that information easily?—Yes. I had hoped to be able to prepare a summary of my notes but I had not time. I had somewhat short notice to appear.*

(Witness withdrew).

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* See Appendix No. IX in this Volume.

MAJOR J. CRIMMIN, V.C., I.M.S., called and examined.

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712. (*The President.*)—I believe you are in the Indian Medical Service?—Yes.

713. And you are now acting Port Health Officer for Bombay?—Yes.

714. For what period of time have you held this office?—I have been acting frequently since 1889. I have been appointed to act nine times and have put in over 4½ years in this Harbour.

715. (*Mr. Hewett*).—How long have you been Port Health Officer since the plague began?—I have been additional or acting Port Health Officer from 27th February 1897 until 6th May 1898 when I went on sick leave and again from 4th November 1898 until date.

716. What is the staff under your orders for the examination of passengers by sea?—The staff at present consists of one Port Health Officer, six medical officers, two lady doctors, one lady nurse, three Assistant Surgeons, two hospital assistants, and one local medical practitioner, 3 clerks, 60 Sanitary Police, a steam launch and some messengers.

717. Is medical inspection enforced not only in the case of vessels going to ports out of India but also in the case of vessels going from Bombay to ports in other parts of India?—The medical inspection at present and since 6th February 1897 is and has been applied to every craft and passenger leaving the Harbour.

718. No vessel can get a port clearance without a Bill of Health signed by the Port Health Officer?—That is so.

719. Which is practically a certificate that the vessel has been medically examined?—Yes, even the smallest craft going to the other side of the harbour have to be medically examined.

720. There has been medical examination on shore since 1st September I believe?—Yes. The crew and passengers of all ships sailing for ports out of India are examined on shore.

721. Please give a description of how you conduct your medical examination; first of the crew and secondly of the passengers?—I will divide vessels into two classes, first those bound for Indian ports, and second, those bound for ports out of India. The crews and passengers bound for Indian ports may be examined on board according to the present regulations, but the majority of them are examined on shore. For instance in the case of the Shepherd Company, who run 35 coasting passenger ships in the week, all the crew and passengers are examined in sheds on shore before they go on board. If a ship is bound for a port out of India the crew are brought on shore from such vessels for examination in accordance with the Venice Convention. The passengers for such vessels are also examined on shore before they go on board. When there are large numbers of native passengers they are fallen into a line in batches of 100 or 200 according to the size of the examination shed. They open their body clothing and a Medical Officer feels each man's chest with both hands, which enables him to detect any increase of temperature. The superficial glands in the neck, arm-pits and groins are then examined. The tongue and eyes are looked at. If he is found to be suffering from a rise of temperature or marked enlargement or tenderness of any of the glands he is sent to a place set apart for such cases to undergo a more rigorous examination. His temperature is taken with a Hicks 1½ minute thermometer in the arm pit, and if he is found suffering from a marked rise of temperature or enlarged tender glands he is rejected. The crew are examined in precisely the same way as passengers.

722. At what precise time do you examine the crew?—Before the passengers go on board.

723. On the day of sailing?—If ships are bound for ports out of India the crew are invariably examined on shore to meet the letter of the Venice Convention. In the case of vessels, which are in dock and which do not want to go to the inconvenience of bringing their crew on shore after they go into the stream, such crews are examined on shore the day before the vessel sails. We again examine such crews on the day of sailing and as near as possible to the time of departure after which no loading of cargo or communication with the shore is allowed. We carry out this second examination for two reasons. First for our own reputation and to do the best we possibly can to keep plague off ships; and secondly, to meet the wording of the Official Bill of Health which states that the vessel with so many crew and so many passengers is at the time of sailing free from plague and certain other infectious diseases.

724. Do you examine each person individually?—Every man, woman and child is examined individually.

725. Do you only remove persons who appear to be suffering from plague?—At the examinations for plague if we find any person suffering from a marked rise of temperature they are detained until such time as the temperature goes down to normal or until we are certain that the fever from which they are suffering is not that due to plague. We go so far as to take out natives with chronic enlargement of the glands of the groin more especially on ships bound for foreign ports. We do this in the interests of the ship and very often at the request of the captain.

726. Why is that?—Because if such a person with enlarged glands was unfortunate enough to be suffering from fever on his arrival at a foreign port from Bombay it is possible that the Health Officer would class him as a plague case or return him as a suspicious case. I have an idea that many of the cases taken out of ships and reported as plague are cases which could be classed as suspicious only, but the medical officer who takes them out as a precautionary measure calls them plague so as to legalize his action. About 85 per cent. of cases reported as plague from ocean-going vessels recover, whereas about 85 per cent. of plague cases in Bombay die. I am unable to account for such a high percentage of recoveries on board of ship unless cases were reported as plague which were really cases with malarial fever and some old enlarged glands. I have some such on record. One was a case at Moulmein. A man was taken out of a ship and it was telegraphed all over the world as a plague case. On writing to the Port Health Officer for details I was informed that the man was taken out as he was suspicious and that he was all right. Still the telegram had gone forth saying that it was a plague case.

727. Is there anything else you would like to say about your procedure?—I would like to put in a memorandum* as it may contain some information for the Commission. If a report is published by and by it may be well to include in it an account of how the examination is carried out in this Harbour so that people in foreign ports may have some idea of how it is done.

728. Perhaps you will give such particulars?—The chief symptoms of plague are a rise of temperature with enlarged glands. All persons suffering with either become objects of suspicion, their temperatures are taken and they are subjected to the most searching examination in private.

729. Will you tell us how the passengers are collected on shore?—We have a shed arranged for the passengers. It is divided into two parts, the larger for the men and the smaller for the women. All women and children are examined by a lady doctor. All the passengers (natives) are formed up to a line and are then examined as described before.

730. Who are the people who record the temperatures in the first instance?—Government Assistant Surgeons or Hospital Assistants.

731. Are they fully qualified to ascertain that point?—Yes, fully qualified as they have all had a medical training.

732. When you have eliminated those who are suspicious the others are passed down the gangway on to the ship and prevented from going on shore again?—They have no opportunity of going on shore again. If the vessel is in the stream she goes to sea at once, and if in dock we make her move off from the dock wall until such time as the Dock Master is able to take her out of dock. In both cases the ship is left in the charge of a Customs Officer and one of my European Sanitary Police.

733. Nobody else is allowed to go upon the ship?—No, except officials.

734. When you were conducting an examination in the stream did you make all the passengers fall in on the deck?—All the first class passengers were examined in the saloon or in their cabins. The deck passengers were fallen in on deck and examined.

735. Is any body except the crew and passengers permitted to go on board the ship after it has been boarded by the Port Health Officer?—No, unless an official such as a Customs or Police Officer or the Agent.

736. When at your second examination on board ship you find a suspicious case do you send it to the shore?—Yes. The names of such cases are entered in a book and they are then handed over to the police, who convey them to a hospital or camp for observation. In connection with the examination

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* Not put in.

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of one of these ships in the stream, one of the vessels took a case of plague to Colombo and on enquiry we found that the ship's articles, both on board the ship and in the Shipping Office, showed that the crew were one more than the number we examined and entered on the Bill of Health. The man who was short may or may not have been on board at the time. If he was on board and felt ill he would naturally try to evade our inspection.

737. Have you arrangements for having a roll-call?—We tried a roll-call from the ship's articles, but as they are not always correct it only wastes our time. We find that many changes have taken place in the crew list on board ships which sign on their crews for a period of six months. We chiefly trust to a statement which is handed to us by the purser. This statement classifies the crew into Officers, Engineers, Quarter Masters or A. B's., native deck, native firemen, and saloon crew. When the crew are being mustered we go around the ship and always into the forecastle.

738. After the medical examination of the crew on shore do you take any precautions with regard to the vessel?—The vessel itself is overhauled and a high sanitary condition insisted on. This includes the painting or lime-washing of crew's quarters; crew's boxes are treated in the same manner. Bilges of native craft are thoroughly washed and cleaned and the holds of all vessels in ballast are swept clean, as well as disinfected when required, as in the case of coal-ships whose 'tween-decks are often used as latrines by the coolies discharging the cargo. Ships' commanders are in addition advised as to the advantage of the periodical inspection of their crew and of the frequent exposure of the crew's kit and clothes to the sun and wind. Printed instructions are sent to the shipping agents for issue to commanders of vessels without medical officers, describing the symptoms and the treatment to be adopted should plague break out on their ships.

739. Could the second examination which you make in the stream be made quite as efficient as the first examination on shore?—The examination we make in the stream is just as efficient as the examination on shore.

740. Do you disinfect articles of clothing of either the crew or the passengers?—It all depends on whether the crew or passenger turns out to have plague. We get very few fully-developed cases of plague at our inspections, and as the majority of the crew and passengers are examined on shore no disinfection of the baggage of those who go on board is carried out.

741. None of the effects of any member of the crew, or of a passenger who is permitted to proceed on board, are disinfected?—Not at present, except that the kits of all crews are exposed to the sun. If we know of a passenger for Europe who has had plague we disinfect his baggage before he is allowed to proceed. This has been done in only a few instances.

742. Do you think it would be an impossible task to disinfect the personal effects of the passengers and crew?—It would be practically impossible owing to the enormous number of crew and passengers who leave Bombay. If we remove a suspicious case from a vessel and if he or she ultimately developes plague while under observation, it is the order of the Government of India that a telegram is to be sent to the next port at which the ship touches, so that they may be warned of the arrival of a vessel from which a case of plague has been removed.

743. The clothing of the other people on that ship is not disinfected before they leave?—No, it is not put through a sterilizer or disinfecting apparatus. We do not know that the ship is an infected one at the time, as the person whom we remove has only a rise of temperature, and this person may develope plague some days after the vessel has sailed.

744. I see that in your précis of evidence you have given the total number of ships which have been inspected. Could you divide them into ships going to Europe and ships going to other ports?—I am unable to do that now, but I can do it later on if necessary.*

745. At the present moment can you give a statement showing the number of outward-bound ships and also the number of inward-bound ships that have been medically inspected since the plague has broken out in Bombay?—I am able to give the numbers from 1st January 1897. Up to the 6th February 1897 only vessels and persons bound for European and other quarantine ports were inspected, but as an exodus of the plague-stricken population of the city had set in, Government in its anxiety to prevent the spread of plague by sea directed that on and after the above date every vessel and native craft, as well as every crew and passenger leaving Bombay by sea, was to be examined before being allowed to depart. From the 1st January 1897 up to 30th November 1898 the number of outward-bound vessels and native craft examined was 87,571. They had a crew of 790,376 and carried 728,759 passengers, making a grand total of 1,519,135 souls.

746. How many of these people which you examined did you refuse to allow to proceed in the ships?—Out of that number we refused to allow 16,798 people to proceed. They were rejected either for having buboes or a marked rise of temperature; many of these were turned into the town and I expect presented themselves again for examination after a few days as soon as their temperature became normal.

747. How many plague cases were developed among them?—149 plague cases were detected or developed among those sent for observation.

748. Mainly among the crews or among the passengers?—Chiefly among the native passengers. The 149 cases are those we could trace, but many were lost sight of at first, as we had no place of observation to which to send them. Rejected passengers were therefore turned into the town in the early days of the epidemic.

749. Did many occur amongst the passengers intending to proceed to Europe?—No, most of the plague cases were among passengers departing for local ports.

750. How many instances were there in which plague was developed on ships during the voyage to Europe from Bombay?—Many cases have been reported from time to time by telegrams to the public press, but when we made enquiries into such cases we found that the cases were not plague.

751. But one or two have been reported to you?—A few.

752. There was the case of the *Pekin*?—Yes.

753. That was a pilgrim-ship which sailed before the pilgrim traffic was stopped?—Yes. She left Bombay on the 20th December 1896 with 1,021 pilgrims on board.

754. She had two cases of plague on board, I believe?—Yes. Two cases of plague occurred between Bombay and Aden. I was Port Health Officer at Aden when she arrived. She was free from plague after that. It did not spread to the remaining passengers.

755. I believe there were two cases of plague on board a troopship?—Two cases were reported on board the *Dilwara* which left Bombay on the 10th March 1897. One case occurred in the family of a man in whose compound plague had been prevalent before they left Bombay.

756. It was a European case?—Yes. In those days we did not examine the troops, women or children going by troopships. It was left to the Military Authorities. But since the case of the *Dilwara* it has been the wish of Government that our lady doctors should examine all women and children sailing on troopships, as men doctors find it difficult for obvious reasons to make the careful examination of women that is necessary.

757. Were there two cases upon the mail steamer *Carthage* lately?—Two cases were reported amongst the native crew. I have some notes here from information sent by the doctor of the ship to my office. The *Carthage* left Bombay on the 2nd July, and on the 6th July a native member of the crew was attacked. He was landed at Aden. A steam sterilizer was taken on board at Aden and the native crews' effects and the ship's dirty linen passed through it. According to the doctor of the ship the man was the last man passed in place of those rejected at the inspection. We generally reject some native crews on board a steamer. Any person with a high temperature or enlarged glands is taken out. On arrival of the ship at Suez she was sent to Moses' Wells by the Suez Sanitary Authorities by whom she was disinfected. The ship's doctor had already done a certain amount of disinfection at Aden by passing the native crew's kits through the steam sterilizer which was taken on board at that port. The report goes on to say that the second case occurred on the 14th July, that is, twelve clear days after leaving Bombay and after the vessel had been disinfected twice. The second case is reported to have recovered.

758. There is no doubt that these were cases of plague?—There is no doubt about the first as he had a left inguinal bubo and died.

759. There have been cases on the mail steamers, I believe, proceeding from Bombay to Aden, have there not?—There

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* See Appendix X in this Volume.

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were the *Shannon* and *Clyde*. The *Shannon* left Bombay on the 5th March 1898 to take the mails as far as Aden only. The postal official attacked complained of being ill on the thirteenth and was reported sick on the fourteenth, after the vessel left Aden on her return trip to Bombay. He arrived here on the nineteenth, was reported by the doctor as a plague case and sent to hospital. It was stated that the members of the postal service complained of an unpleasant smell on the day after they left Bombay on board that part of the ship where they were working and near to which was the cabin occupied by the postal official before he fell ill. Some days after this smell was noticed dead rats were found in the store-room of the ship daily for several days. Some dead rats were found also after the ship returned to Bombay, but their death was attributed by the officers of the ship to carbolic acid poisoning. They said the rats must have drank the carbolic acid put down in the bilge to disinfect it.

760. No attempt was made to find out whether they were suffering from plague?—We sent some of them to a bacteriologist, but he said they were not fresh enough to enable him to say whether or not they had plague microbes.

761. What are the facts of the case on the *Clyde*?—The *Clyde* left Bombay for Aden on 13th April 1898 and landed a case said to be plague. He was a native mail sorter and he recovered. I may mention that the P. and O.. Company have issued certain orders to their Commanders and Surgeons in connection with plague. The following is an extract: "Should any case of sickness accompanied by high temperature among the native crew or postal staff come to the knowledge of the Surgeon before the expiration of ten days from leaving this Port (Bombay), it should be treated as suspicious and the man isolated and reported to the Aden authorities.

762. Was there any case of plague on the *Bengal*?—It is very doubtful. The *Bengal* left Bombay on the 20th August for Aden. She returned from Aden and arrived here on the 1st September. On the fourth, while the vessel was in dock, a native fireman was removed by the police to the Ripon Road Plague Hospital where he recovered. The vessel was sent out into the stream for disinfection. The man was away from Bombay from the 20th August till the 1st September. If it was plague the man most likely contracted the disease on his return to Bombay and should, therefore, not be shewn as a case that had left Bombay. For certain reasons the Port Health staff never diagnose a case as plague. Such cases are sent to a hospital, and when the case is reported officially as plague we then disinfect the ship.

763. Does that list exhaust the number of cases that have occurred?—There are some more steamers, I regret to say. The *Patna* left Bombay for the Persian Gulf, *viâ* Karáchi, on the 24th March 1898. She was loaded in the stream, chiefly with grain. She arrived at Karachi on the 26th March when she was inspected by the Port Health Officer, who reports that everything was correct. The crew were again examined at Karachi on her departure for the Persian Gulf on the 28th March, and a coal-trimmer, who had been on the ship's articles since the 11th January, was found with a temperature of 103. He was removed from the ship and recovered. According to the statement of the officers of the ship the second saloon passengers complained on the twenty-sixth of an unpleasant smell in the saloon which is near the forecastle, and on the 28th (the day the ship left Karachi) the Chief Officer found two dead rats behind the pipe casing of the saloon. On the 31st March a lascar complained of being ill of fever and died on the 4th April. The man was examined by the members of the Russian Plague Commission who certified as follows: "We found him suffering from a grave form of fever. The more definite signs of plague, such as buboes and the characteristic aphthous tongue, we found wanting. Taking, however, into consideration the rapid death of the sailor and the case of plague stated to have occurred in another sailor detained by the Port Health Officer at Karachi and notified by telegram to Bushire, together with the arrival of the ship from a plague-infected country, the case under consideration appeared to us suspiciously in touch with the epidemic at present raging in India." Another death occurred among the deck passengers on the same ship and was certified by the members of the Russian Plague Commission as follows: "We certify that he had neither fever nor buboes nor any other symptoms. He certainly has not died of plague." Fakir Chaukir, another one of the crew, was reported on as follows by the members of the Russian Commission: "We, in view of the high temperature (40'2) and persistent temperature of the sick man, the great size of and the complete absence of pus in the bubo, after an incision three centimeters in depth and half a centimetre long, together with the aphthous state of the tongue, hereby declare the hereinnamed Fakir Chaukir to be suffering from plague."

764. You have no doubt that his death was caused by plague?—I can't have any doubt about it.

765. Are there any other ships which had cases of plague on them?—There was the *Ballarat* and *Bengal*, but I do not know anything about them as I was away on leave at the time. The P. and O. *Ballarat* left Bombay for China on the 16th August last. The P. and O. *Bengal* left Bombay on the 11th October. This is the vessel whose articles showed that she had one crew more than we examined and entered in the Bill of Health. The case that took place on each of these ships was reported from Colombo. We have not the details. The ships were put into absolute quarantine at Colombo and the authorities would have nothing to do with them.

766. If there had been other cases you would probably have heard of them?—Yes, because such cases are telegraphed all over the world as an item of news.

767. The result shows that remarkably few plague infected people have managed to leave Bombay?—Very few genuine cases have got through us on ships bound for foreign ports.

768. When was the inspection of incoming vessels started?—The inspection of ships coming to Bombay from plague infected ports commenced in April 1897. This was after the first exodus had taken place and when plague had been scattered to all the coast ports of Western India. The death-rate from plague in Bombay had fallen, and the people commenced to return, so every person arriving from ports between Karachi on the north and Bhatkal on the south of Bombay was examined. We continued these examinations up to the 20th April 1898. After that date and up to the present time only vessels which touched at infected ports were examined. The coasts ports of Western India are now practically free from plague.

769. How about Karachi and one or two other places?—Karachi has one or two deaths a week, and at Cutch-Mandvi there are a few deaths weekly. The Cutch districts and some of the Kathiawar country have a few cases of plague, but ships do not touch there.

770. But compared with what it was previously, the coast has ceased to be infected?—The coast has practically ceased to be infected.

771. Can you state how many in-coming vessels you have examined?—The total number of incoming vessels examined up to date is 50,177. They carried a crew of 391,194 and brought 482,003 passengers, in all 873,197 souls. Of these incoming crew and passengers 43,477 were segregated for periods varying from 2 to 10 days. That was at the time when the Bombay Plague Committee had control of the operations. We ran the inspections for them with the staff they gave us. As Bombay had not many cases of plague at the time the Committee put all arrivals from heavily-infected ports into observation camps.

772. Were they under your charge?—No, the camps were under the charge of the Plague Committee. Persons coming from slightly infected ports and who were suffering from fever were kept under observation until their temperatures became normal, which usually took place within one or two days; whereas persons who came from heavily-infected ports and from infected ships were detained for periods varying from 8 to 10 days according to the distance of the infected port from Bombay. Many of the above-mentioned 43,477 persons who were sent to the observation camps were allowed out on the surveillance system. The heads of castes stood security and guaranteed that they would present themselves for medical inspection as often as was required. Before people were allowed out of the camps they were photographed in groups. The system is said to have worked well, and few cases of plague were found amongst those segregated after the suspicious cases had been weeded out by the Port Health staff. The actual number of plague cases detected at the inspection on arrival or that developed amongst those suspicious cases which were sent for further observation was 48. Besides, the number of plague cases discovered at the inward and outward inspections 36 more were found on board ships in the Harbour, or on native craft plying between the various landing places and are shown as Harbour cases. Therefore the total number of plague cases accounted by the Port Health Officer is 269.

773. (*Dr. Ruffer.*) Were you medical Port Officer here when the plague broke out two years ago?—No. I was at Aden at the time.

774. When the plague broke out in Hongkong and Canton certain quarantine rules were enforced in Bombay for some-

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time?—Yes. From 29th June up to 25th September 1894, and again from 7th April 1898 to 24th August 1898.

775. Could you tell me what these quarantine rules were? —I have not a copy of them by me, but they were to the effect that ships coming from the infected ports should hoist a yellow flag before entering the harbour and were to be kept in charge of the pilot without any communication with the shore until visited by the Port Health Officer. If the vessel had a doctor and no plague during the voyage she was granted immediate *pratique*. If she had plague or had no doctor on board the rules provided for her quarantine for a certain number of days.

776. Was there any disinfection of the clothing or of the ship at the time?—No, because no ship which arrived from Hongkong had plague on board during the voyage, and as well as I can remember only one ship arrived without a doctor on board.

777. Up to what date were these rules in force?—Up to 25th September 1894, and from 7th April 1898 to 24th August 1898.

778. Has there been a medical examination of all the passengers and crew?—Yes.

779. The ships coming from Hongkong?—Yes.

780. And Canton?—That port was included in the rules, but we had no ships from Canton.

781. When a ship comes from a non-infected port to Bombay, or a port which is supposed to be non-infected, what are the precautions you take; does anybody go on board or does the pilot only go on board?—No person goes on board but the pilot. Pilotage in the Bombay Harbour is compulsory, and according to the medical inspection rules, under which we worked before the plague broke out and which are still in force, the pilot on boarding a vessel is to enquire if the vessel has, or had during the voyage from which she is arriving, any cases of yellow fever, plague, cholera, small-pox, measles, scarlatina or black leprosy. If so, or if she has had two or more deaths on board which cannot be satisfactorily accounted for by the doctor or Captain, the ship hoists the doctor's flag and has to remain in quarantine until she is visited and *pratique* is granted by the Port Health Officer.

782. When there are two or more deaths?—Yes; but that applies chiefly to pilgrim ships, as pilgrims have almost always deaths on board. We visit such ships and the signal is run up so that we may know the vessel is entering the Harbour.

783. In an ordinary case the medical officer does not go on board?—No.

784. In the case of a ship coming from an infected port the medical officer always goes on board?—Yes, always. The ship is not to have communication with the shore until the Port Health Officer has given *pratique*.

785. What measures do you take to ensure that there is no communication with the shore?—As Bombay is infected there is no absolute necessity to put a guard on board.

786. But before Bombay was infected?—We never had any plague to deal with.

787. But Hongkong was infected in 1894 and Bombay in 1896?—The pilot and Captain have orders to take the ship to the quarantine ground and to keep her in quarantine until granted *pratique* by the Port Health Officer.

788. If no one went on board from the Health Office, the ship would be left in charge of the pilot?—Yes, till the early morning if the ship came in at night.

789. Does the medical examination always take place by day?—Always by day, of outward-bound vessels. But when the people were rushing in here from coast-ports, some 800 or 900 passengers could not be kept on board all night. We got one of our examination sheds fitted up with electric light. The ship came alongside the wall and discharged her passengers in batches for examination. These coasting passenger steamers to which I refer were timed to arrive at 6 P.M., but we were unable to get through our work until very often two hours after dark.

790. In the case of a ship coming from an infected port after a voyage of more than ten days, do you have a medical examination?—We have no infected ports more than ten days from Bombay at present.

791. But you would if there were such a port?—Yes. Our rules compel us to do so.

792. In the case of a ship starting from an infected port and going to a non-infected port and receiving *pratique* there and coming here, suppose, for instance, a ship starts from Hongkong, goes to Colombo, and then comes here; is that ship inspected on coming here?—It has been the custom. There were orders published at other ports exempting from quarantine regulations arrivals from infected ports provided they had been granted free *pratique* at some intermediate port.

793. Do you make a difference between a ship carrying a medical man and a ship not carrying a medical man?—No, all arrivals at present from infected coast ports are treated exactly on the same principle.

794. I find in a letter, No. 3070, dated Bombay, 2nd July 1897, to the Bombay Government from the Commissioner of Customs, on the subject of quarantine rules, that the following passage occurs in paragraph 12:—

"Every Peninsular and Oriental Company's liner, during the height of plague, on arrival in Bombay was, under the law and practice of the port, forced to discharge its native crews; by law the crew can and do claim their discharge. Three or four days, sometimes one day, before a vessel's departure another crew has been signed on the articles. This fresh crew has come from the slums of plague-stricken Bombay, whilst the passengers, who are almost all Europeans have come from up-country stations and have boarded their vessels direct from the train." Is that the case still?—We have sent round circulars from time to time asking the Companies to help us in every possible way to prevent the export of plague. One was to ask the agents to ship their crew as many days as possible before the time fixed for sailing, but they found a great difficulty in getting crews to come on board. Native firemen as a rule will not come on board until a day or so before the ship sails.

795. That particular company does not put the crew in quarantine for sometime before hand: they embark the crew just a day or two before the passengers?—I am not aware that they put their crew into quarantine. As a rule they take their lascars on board some days before the ship sails, but they are not kept in quarantine on the ship. It is difficult to get firemen to come on board until the day before sailing. On one or two occasions since plague broke out I understand the Peninsular and Oriental Company had a difficulty in getting firemen and had to transfer some from other ships.

796. Several ships on which plague occurred belonged to that Company?—Some did belong to the Company.

797. The *Clyde*, the *Shannon* and the *Carthage*?—Yes.

798. The *Pekin*?—No, she was a pilgrim ship and was sold out of the Peninsular and Oriental Company some years ago.

799. One or two cases of plague occurred in London on board another Peninsular and Oriental ship: two Portuguese are supposed to have had plague?—It was stated that they were plague cases, but we have not heard if the diagnosis was verified by a bacteriological examination carried out by a man with sufficient practical experience of plague to enable him to convince a practical bacteriologist that the microbes were those of plague.

800. How do you explain the presence of plague on board those ships where every person was examined: take the last case on board the *Carthage*?—The second case on board the *Carthage* occurred 12 clear days after the vessel left Bombay. Assuming that it was a true case of plague it shows that the person could hardly have been infected from his clothing, because the ship had been disinfected twice, first at Aden and again at Moses' Wells.

801. The first case occurred before Aden?—Yes.

802. Therefore disinfection would not touch that case?—No.

803. The boat was going from Bombay to London, it got to Aden within five days?—Yes, the man got ill one day before getting to Aden. He was reported by the ship's doctor as a man with a suspiciously high temperature in accordance with his Company's orders previously referred to. The man was treated as a case of plague.

804. Have you any reason to believe that it was not a case of plague?—No.

805. Still there have been cases landed at Aden as plague and the Governor of Aden afterwards notified by telegram that it was not plague: in this case, if I remember rightly, he notified that the case was plague; was that not so?—He

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* Printed on pages 347–519, Vol. III., Nathan's "Plague in India, 1896-97."

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would probably notify his Government, but not the Port Health Officer, Bombay.

806. I believe in the case of the *Carthage* it was notified to the Powers as being plague: in the case which occurred afterwards, after the ship had passed through the Canal, after it had been disinfected twice, there was a second case which was also notified as plague?—I was at home at the time. I remember reading in the telegrams that the *Carthage* passed close to Malta and signalled it.

807. Have you any theory as to how these two cases occurred on the *Carthage*?—No, I have no theory as to how they became infected.

808. Is it not a fact that on board the *Carthage* there were several other firemen with enlarged glands, and that these men were landed at Moses' Wells, kept there for several days, and then shipped back for Bombay?—I have not heard of it, but if such was the case the presumption is that none of them were suffering from plague, otherwise the Moses' Wells authorities would not have sent them on board-ship and returned them to Bombay. As I stated before, we do not allow native crew with marked enlargement of the glands to proceed on boardship to foreign ports. We do this to save the ship the possibility of getting into trouble in case she touches at a port where there may be a nervous doctor with no experience of plague, and who may possibly lose his head and thereby cause an immense amount of unnecessary harm and inconvenience to the commerce of the port from which the vessel comes.

809. I had the pleasure of seeing your examination of cases this morning, and the examination of the ship, too. There is one point I would like to ask you with regard to the disinfection of infected and suspected articles. According to the Venice Convention, in Chapter I, Section II, paragraph 2, there is prescribed "compulsory and rigorous disinfection, on shore, under the superintendence of a doctor appointed by public authority, of every contaminated or suspected article in the manner prescribed in paragraph 5, Chapter III, of the annexure to this Convention;" what do you consider an infected or suspected article?—I would consider the clothing, bedding and baggage of a plague patient as infected.

810. You have not taken the view that the clothing of a person coming from Bombay is infected or suspected?—If I did I would be compelled to disinfect it, and it would be practically impossible for me to do so under present conditions.

811. Leave the practical point of view out of the question?—It would be difficult to bring oneself to believe that every article in an infected city is infected and requires disinfection, more especially as we examine almost every person on shore and only permit healthy people to go on board.

812. You think it would be impossible to disinfect the clothing and personal linen, say, for instance, of every person leaving Bombay?—No; if we had a large enough staff and sufficient disinfecting stores to disinfect the clothing and personal linen of every person leaving Bombay. 921, 828 crew and passengers left last year for the coast and other ports. I am afraid though, that if it was done, it would disorganise the coasting passenger traffic.

813. Do you think it would be a wise protection to take?—Yes, more especially at times when plague is epidemic. We went so far as to draw up working rules for disinfection, which Government approved of but did not put into force, as the plague deaths in Bombay had dwindled down to 20 or 30 daily.

814. Are you of opinion that some of the cases of plague occurring on boardship have been due to a neglect of this precaution?—It is very difficult to say. In addition to advising the Captain verbally we attach a printed slip to the Bill of Health pointing out the advantage of keeping his forecastle and native crews' quarters and boxes perfectly clean, and of exposing their bedding and clothing to the sun and air as often as possible. I think that if bedding and clothes are exposed to the intense heat of the Indian sun any plague microbes which may possibly be in them would be killed or rendered innocuous.

815. I do not understand whether you yourself disinfect the ship, or whether the disinfection is done by the Captain or crew?—The Captain and crew assist, but we are responsible. Either myself, one of my staff or one of my European Sanitary Police is present while it is being done.

816. So that it is practically done under your supervision?—Yes, and the ship is not granted *pratique* until I go on board and satisfy myself that everything is perfectly clean.

817. I notice among the susceptible articles in the Venice Convention they include "rags, * * raw hides, untanned fresh skins, * * human hair." Excluding rags and used linen clothing, do you believe that any of these other articles can contaminate a ship or carry plague to another country?—I do not know. There is an idea that bags can do so on account of rats leaving microbes in them. An effort was made to prove that the second epidemic of plague in Karachi was due to bags imported from Bombay, but the evidence was weak and very far from conclusive.

818. As a matter of fact is there a single well-authenticated case of plague having been carried by any of these articles?—Personally I have had no experience of these things and have not had time to enquire as I spend all my time examining crews and passengers.

819. Could you tell me whether as a matter of fact certain countries, such as Germany, allow these articles to go in?—I am unable to say.

820. You have told us something about rats dying on board the *Clyde* which was said to be due to carbolic acid poisoning. Did I understand you to say that six rats were supposed to have died?—Several rats, probably more than six, were said to have been found on board from time to time.

821. It is a fact that when ships are properly disinfected with sublimate or carbolic acid a great number of rats on boardship die; have you any experience as to that?—I have not noticed it.

822. You have not heard of it from captains?—No.

823. (*The President.*)—I judge that you trust to two chief symptoms in detecting plague at ports—temperature and buboes?—Yes.

824. Do you take them in combination or might you take them singly?—As a rule we have to take them singly, because we seldom get a fully-developed case of plague at the time of inspection. The examination at this port is supposed to be the strictest that can possibly be devised, and as soon as people got to know of it they would not come to our examinations if they were ill for fear of being kept and placed under observation. If a native with a chronic enlargement of any of the glands of the neck, armpits or groins presented himself and was found free from fever, he would in all probability be allowed to embark if bound for one of our coasting ports. We keep such cases back in the interest of ships bound for foreign ports unless the man is provided with a medical certificate. Even then the name is entered in the log book. We do this so as to prevent the ship being compromised in the event of a man with an enlarged gland developing fever when she is in a foreign port.

825. On the other hand if he had a rise of temperature without enlarged glands would that be a reason for your taking action?—Yes, unless he can satisfy me that rise of temperature is not due to plague.

826. What do you mean by a rise of temperature in that way?—A well-to-do native may be suffering from fever due to malaria or phthisis, and if he produces a certificate to that effect he would be allowed to go. He can show such a certificate at the port of arrival and he will not then run the risk of being classed as suffering from plague, more especially if he is in a dying state from the exhaustion or seasickness caused by the voyage. Again, if we find a passenger with a temperature of 100 or even 100·5 and with no other symptoms of plague, such as enlarged glands, injected conjunctiva, or furred tongue, we would allow him to embark at a time when plague is not very bad, but if he presented himself at a time when plague was virulently epidemic he would be stopped if his temperature was 99·5. All our temperatures are now taken in the axilla and not in the mouth. We find at our examinations that armpit temperatures are much lower than when taken in the mouth.

827. From your experience with regard to the ports to which ships proceed from Bombay can you tell me if they go much to Madagascar?—As far as I know this port has no direct trade with Madagascar.

828. (*Dr. Ruffer.*)—Is it not a fact that ships going through the Suez Canal starting from Bombay, for instance, and going to Brindisi—say a P. and O. steamer—take up firemen at Aden?—They do not take any men from Aden itself, but ships from here take men to Aden who are transhipped to other steamers belonging to the P. and O. Company. The Messageries Maritimes Company entertain crews at Aden.

(Witness withdraw.)

LIEUTENANT-COLONEL T. S. WEIR, I.M.S., called and examined.

829. (*The President.*)—I believe you are a member the Indian Medical Service?—Yes.

830. And you are now Municipal Health Officer here?—Yes.

831. How long have you been Health Officer?—Since 1873.

832. You have had an opportunity of seeing the whole of the plague in Bombay?—Yes.

833. Therefore, I presume, you will be able to give us most valuable information with regard to the several epidemics, and with regard to the general condition of things in this city. Can you tell us about the population and the water-supply?—The area of Bombay* is about 22 square miles, and the population in 1891 was over 8 lacs, over 800,000 people. Bombay is the most densely crowded city in India, the six sections of the greatest density of population having 227,021 people on an area of 403·28 acres. An idea of the density of the population of the most crowded sections may be gathered from the following table:—

	Population.	Area.	Persons to an Acre.
Khara Talao . .	27,036	40·33	670·39
Chuckla . .	32,197	51·23	628·47
Kumbharwada .	32,209	52·23	616·65
Market . .	44,751	83·63	535·10
Bhuleshwar . .	38,363	71·73	534·82
Umarkhadi . .	52,466	104·12	503·85
	227,021	403·28	

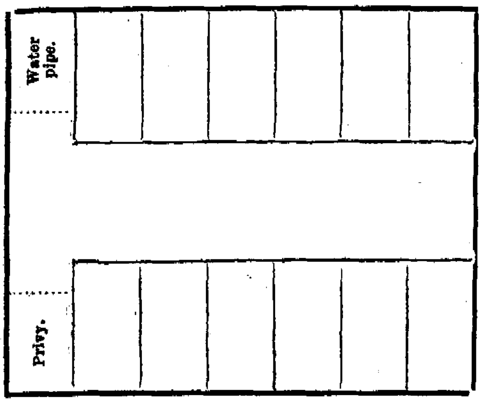
This population is concentrated in houses that are very closely packed and very often very imperfectly ventilated. There are in some houses in Bombay over a thousand persons, distributed in rooms, a family, or even more amongst the outcaste population, to each room.

834. Do you know what the area occupied by such a house would be?—No, I could not tell you now; it varies.

835. How are such houses ventilated?—The means of ventilation are galis under three feet wide on each side of the house, and sometimes an open space in the centre about 15 ft. by 15.

836. Do you mean the whole four sides or three sides?—I mean on two sides, the greatest length.

837. There may be wide openings in front on the other two sides?—Yes. In one of my reports† I gave a sketch of a typical house occupied by the poorer classes, such as you inspected yesterday morning in Kamatipura. This is a house of perhaps the worst type. The plan is as follows:—



If you look at the rough plan, you will see that there are lines of rooms separated by a narrow passage. In front is the street, behind is a little open space, say six feet broad, and five feet long. On one side of this little open space there is a water pipe and on the other side are the privies. In this little space the people wash not only themselves, but their clothes.

838. How wide is it?—It varies. You may take it on an average to be about five feet.

839. I observe there are twelve rooms?—Yes.

840. What is meant by a room? Does a room mean a house actually?—A room means a compartment having a separate door or entrance.

841. Is it occupied by one family, generally?—Yes generally by a family; but amongst the outcastes, it may be occupied by several families.

842. How large would the space itself be?—You might take it on an average to be about 10 feet square.

843. It is not very lofty, I suppose?—No.

844. How many people would inhabit a room such as that?—I think the numbers would average about five. I am only speaking of the poorest classes. Amongst the Musalmans the number of people would be very much smaller.

845. Has the house you are describing one storey or several storeys?—Several storeys.

846. Is it a lofty house?—Yes, it is a lofty house.

847. You were going to say something more about the ventilation?—The difficulty is with regard to ventilation at night. There is a front door which closes the central passage. Where there is not over the front door an open grating, the ventilation (except in cases where there happens to be what is called a chauk over the stair case) is from a little space at the back where the privy is.

848. That opens outside of the house into what?—That opens outside the house into what is called the sweepers' gali, a small gali.

849. Which is not very sweet?—The galis in many parts of the town are good. The defect, as you observed yesterday, is in regard to the pavement permitting percolation, fluids percolating down between the stones when the cement is worn away. The surfaces of the galis are clean.

850. The old galis are very irregular?—Yes.

851. What light is there in houses of this kind?—The light is extremely defective. Even in the case of a better house than that I have described the lighting is very dim indeed.

852. What does it proceed from?—The light would proceed from a door communicating with a central passage and from a window communicating with a side gali outside, a gali 1 ft. 6 in. to 3 feet.

853. One of those narrow galis I saw?—Yes.

854. The outside wall of this gali being the wall of another high house?—Yes.

855. What is the condition of the bottom of this gali?—The galis are paved with slabs of stone having a certain gradient, or fall, and roughly cemented together.

856. Is there much filth found in these places?—Over these galis there is a constant passage of fluid carrying excreta containing organic matter. There is a continual throwing out from the windows of solid matter on to the gali: in fact, the galis are the ash-pits of the houses in Bombay. There are no ash-pits here.

857. In the case of one of these rooms, the ventilation would be by a dark passage, or else by a small opening into the gali outside?—Yes, separating the house from adjoining one.

858. The light is not good?—No, it is not good.

859. It is very dark in the passage?—Yes, sometimes.

860. You could not see to read inside the room?—It would not be easy in a house of this kind.

861. It is merely a dark den?—Yes.

862. That is typical, I suppose, of the worst form of houses?—Yes. Then there is another difficulty about the houses in Bombay, namely, that although the tenants themselves are very clean, and keep the rooms clean, they do not always feel any individual responsibility of keeping, for instance, the central passage clean, or the open space at the back. They think that the landlord should look after the central passages or other open spaces within the building.

863. Upon whom does the legal responsibility fall?—Upon the landlord.

864. And does he not attend to it?—Some landlords do keep servants to clean out the inside of buildings but other landlords think that the tenants ought to do it. They rather dispute the justice of having to do it.

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* For plan of Bombay, see Appendix No. XI in this Volume.

† *Vide* Report on the outbreak of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I. C. S., page 189.

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865. Of course there is a great variation from this type: there are very much better types?—Yes, very much better types indeed.

866. What proportion of the habitations of Bombay may be represented by this better type—a large or a small proportion?—A considerable proportion. There are many excellent chawls. The chawls are not the worst ventilated buildings.

867. On the other hand, how much of the population would reside in houses of the worst type, or not much better—a large part of the population or a very small?—A very large proportion of the poor population would reside in houses or in rooms which are very badly ventilated. The difficulty with the poorer classes is their intense desire to have seclusion, to put up little screens to secure privacy.

868. Perhaps you might tell us in the next place, what kind of improvements is likely to be effected by the Bill, which I now understand is under consideration, for the amendment of the Municipal Act at present in force in Bombay?—A new Act is under consideration. It will give more open space inside and outside.

869. Do you think it will satisfactorily meet these grave defects?—Yes, I think so. I think our draft proposals will satisfactorily meet the question of light as far as can be done by a public Corporation. Unless the poorer classes help themselves, you can only assist them to a certain limit.

870. Under the provisions of the new Bill light will always be given to them?—Yes.

871. Something will be done to improve ventilation?—Yes.

872. And as to privy accommodation?—The present rules are not very effective with regard to privy accommodation. This Act will lay down that there should be an open space. The practical difficulty is this, that to disconnect a privy properly it involves exposing the people to the monsoon rains; and although an open space of three feet is laid down in the Municipal Act, it is difficult to carry it out.

873. Have you power to prevent the nuisance of throwing rubbish into the galis and about the passages?—We can prevent nothing. Our sole power rests in the prosecution of people after the commission of offences. We have the power to prosecute them for doing so. The Magistrates fine them.

874. In the new Act will you have any power to erect dust-bins?—Yes; we have a very large number of dust-bins at present. We can do so now. We have permanent dust-bins and portable dust-bins.

875. As to this pollution of the air by excrementitious matter in open channels, will that continue, or will the new Act give you power to prevent it?—The new Bill, speaking generally, gives us much more power than we have now. I do not object to open channels in the proper positions with proper gradients and well cemented. We have some excellent open drains and galis perfectly sweet.

876. And you are satisfied with the power you will have?—It will give us more power. From our executive point of view, there is, of course, an alteration of the law necessary, namely, that the executive officers, the Municipal Commissioners and Health Officer, should have the power of Magistrates. It has always been opposed on principle, and I suppose will continue to be opposed. There are objections to it.

877. That, you think, will facilitate the procedure?—I do not think a Magistrate who does not see the commission of it can ever appreciate the nature of the nuisance in the same way as the officer who sees it.

878. What is the present condition of the law here with regard to over-crowding?—In the Municipal Act there is no limit laid down as to the amount of space to be allowed to each person. There is also a doubt as to the interpretation of the Act, as to whether over-crowding in one particular portion of a building constitutes over-crowding in the whole building or not. The section is altogether weak indeed.

879. In the new Act are you likely to get power to see that a room must not be occupied by more than a certain number?—That is proposed.

880. That would be a great improvement?—A very great improvement indeed. But it must be enforced by the aid of policemen. An order of a Magistrate will not influence overcrowding in the least.

881. Will you tell us what districts in Bombay you have referred to as being in this bad condition?—The most insanitary districts of Bombay, so far as overcrowding is concerned, are the districts that I have referred to—Kharatalao, Chuckla, Umarkhadi, Kumbharwada, Bhuleshwar and the Market.

882. Will you give us some information as to the health of the districts relative to the whole of Bombay?—The mortality in Bombay fluctuates very considerably. For instance, in 1897, the year for which the last published report has been declared, the mortality fluctuated between 88 per thousand in the district outside this office and over 100 per thousand in the second district inspected yesterday, Nagpada. That includes plague.

883. Take an average of five years before the plague?—The average holds pretty good. The mortality fluctuates between 50 per thousand round where you were yesterday, Nagpadas, and 10, 15 and 20 per thousand towards Malabar Hill or the suburbs.

884. Are there any special diseases attributable to bad sanitary conditions which are prevalent in the most insanitary districts?—Phthisis, and the lower forms of fever; a depressed public vitality I should say.

885. Notwithstanding that one would not anticipate that phthisis would be prevalent in this climate?—There is an enormous mortality from phthisis amongst secluded families.

886. How do you account for that?—I refer in my reports, not only to the imperfect ventilation of the buildings, but to the seclusion in which a large number of families live.

887. The bad air?—Yes, bad air and hence the survival of the disease; and also you have to add to bad air, in the case of the poorer classes, the very laborious lives they lead; over a 100,000 sleep on the ground on a cotton sheet.

888. That is also a damp district?—Yes; that is the centre of the valley, undoubtedly.

889. Are there any other diseases?—Remittent fevers; they cause a heavy mortality. Then you have to add to that the epidemic diseases—small-pox, cholera, measles.

890. They affect these localities more than others?—Yes, they affect these localities more than others. Before an epidemic comes, you can map out its course if you have two factors, the buildings and the classes of the population. Our mortality in Bombay is to be found not only by the buildings, but by the classes of the population. For instance, I will take 1897. The mortality in different classes fluctuated between 18 per thousand amongst Europeans, 32 per thousand amongst Parsees, and 102 per thousand amongst Hindu outcastes.

891. Is that a racial difference, apart from a difference you might expect from these people mainly occupying districts of different degrees of sanitation?—Partly that, and chiefly the economic conditions, the conditions which influence the people in selecting certain localities and certain buildings.

892. Perhaps you will now give us a description of the plague itself. What occurred in Bombay and what was the origin of the plague?—The total mortality in Bombay increased from 2,299 in July 1896 to 2,669 in August. This mortality, when analysed, was caused by an enhancement of the number of deaths among people born outside Bombay, whereas the mortality amongst the people born in Bombay decreased by as much as 23. The total mortality fell from 2,669 in August to 2,616 in September; and the deaths, examined according to place of birth, show that the mortality amongst persons born in Bombay had decreased by 84, whilst the mortality amongst persons born outside of Bombay had slightly increased. The total mortality in October amongst people born in Bombay increased, but in November it decreased by 75. The total mortality in August increased and in September decreased, and in October began to rise. The epidemic was preceded by exceptional phenomena. The mean annual temperature for the year was the second highest on record during 51 years. The rainfall was abnormal; instead of being distributed over four months or so, it was distributed over a much shorter period. The monsoon current ceased within two months. The rainfall in June, July and August was heavy, nearly 30 inches over the average. In September the rainfall ceased, only 1·6 inches fell. Even in the famine years of 1876 and 1877 the rainfall was much over 1·6 inches in September. There were great floods in the beginning of the monsoon, and in the last days of July all communication was stopped and the low-lying country around the island was submerged. The water supplied from Tansa was stopped, and consequently there was some difficulty in obtaining water quickly in Bombay. In September the godowns in Mandvi were still damp inside, and the wood-work in some of them mildewed. We had therefore

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the following abnormal phenomena—(1) an abnormal season of rainfall that lasted only about half the normal period; (2) an abnormally high level of sewage after heavy rain in the arterial sewers of the city; and (3) wet grain in dark and damp godowns or granaries underneath human dwellings. In 1896 there was a great increase in the number of rats, and the damage done was so great that the dealers in grain had to calculate a margin on account of it.

893. The increase was so marked as that?—Yes, the grain merchants had to take an account of it as one of the items of loss.

894. And that is very unusual?—That is very unusual.

895. These are the conditions preceding the epidemic?—Yes.

896. What in your opinion would be the general result?—It is difficult to form any opinion. Those are the conditions we observed; and it would be extremely interesting to observe whether these conditions are observed in other places or not.

897. Some would increase the price of food, and deteriorate the quality of food?—Undoubtedly. In August I apprehended an immigration of famine-stricken people, and there is no doubt that an immigration of destitute people took place during the monsoon.

898. Some of the conditions you have mentioned would also increase the insanitary condition of the lower parts of the town?—Undoubtedly. For instance in 1896, for a fortnight after the heavy rainfall had ceased, the shady streets of Bombay were still damp.

899. And I suppose the food was injured by the grain being wet?—Undoubtedly. Fermentation was assisted.

900. Those were not favourable conditions for resisting an epidemic?—No.

901. Will you proceed with what you were saying about the epidemic?—In July an outbreak of foot and mouth disease occurred amongst cattle, and it suddenly subsided in August, instead of continuing through the monsoon, as it generally does. In the beginning of September my attention was drawn to four deaths that had occurred in Mandvi. In August three deaths occurred amongst pilgrims on their way to Nasik fair. The pilgrims came from Upper India, and a large number passed through Bombay on their way to Nasik. It must be remembered that in August the mortality in districts of country close to Bombay rose. For instance, in Thana the mortality rose from 1,848 in July to 2,691 in August. That is a curious fact. There is no evidence to prove it; but there is an impression that a disease similar to plague has been epidemic close to Bombay, close to the harbour. The hakims say that a disease with similar symptoms had occurred here and around Bombay for many years.

902. Is that a low population?—It is a sea-faring population.

903. Who are the medical practitioners who look after them?—The medical practitioners are unqualified.

904. Are they natives?—Yes, they are natives.

905. There are no English or qualified practitioners?—There are, of course, in the districts; but the difficulty everywhere is in regard to the small number of people who consult qualified practitioners. In the Poona Collectorate, also, the mortality rose from 4,384 in July to 5,286 in August. The increase in the mortality in this city was synchronous with the increase of mortality in other places close to Bombay. When the disease was recognised in Mandvi, the people began to migrate across to Walkeshwar and to the north of the island; but the epidemic did not develope with them. Whenever cases were known to have escaped from the island, telegrams were sent out to those places to which they were supposed to have fled.

906. Did the mortality in Mandvi decline?—The mortality in Mandvi commenced to decline in the end of October, but the progression of the disease was observed to continue westward, southward and northward. At a future date I can produce, if the Commission wish, a diagram showing the progress of the mortality in this section of Mandvi. I can put in a diagram showing the total mortality in Mandvi. As I said, the progress of the disease continued westward, southward and northward. The disease had not become epidemic in the north or the west until towards the end of the year. The question, of course, arises as to the explanation of this progression of the disease, east to west, south to north. The only explanation that has ever occurred to me which seems at all probable is that the disease was carried by rats. This is a diagram showing the mortality in September, October and November of 1896, 1897 and 1898.* This is a plan of Mandvi† showing the order in which the first recognised cases occurred. I have brought another diagram here in case the Commissioners should wish to look at it, but I do not propose to put it in: it is a diagram showing the relation between the mortality and what is practically the evaporation. It is a curious coincidence that in Bombay the period of the highest mortality was the period when the evaporation was greatest.

907. Will you now pass to the question of the methods which you have adopted to meet the plague?—I put in a return showing the number of cases registered.* Knowing the difficulties in the diagnosis of the disease, it is extremely difficult to say that the return is correct. There has undoubtedly been a very large amount of under-registration: at the same time there has been, especially in 1896 and 1897, an amount of over registration of plague. It cannot be absolutely relied upon. It is simply the number of registered cases. The number of registered cases up to the end of November comes to 35,141, of which 30,654 died: that is equal to a mortality of about 87 per cent. I prepared a register giving the mortality from plague. The highest mortality occurred in Mandvi, 8·25 per thousand. The next highest mortality occurred in Kamatipura, 7·77 per thousand. Then Middle and Lower Colaba, 5·65.

908. Will you kindly proceed now to describe the measures you adopted?—The people did not, and could not, believe that the disease was as dangerous as we pronounced it to be. That was one of our great difficulties. They expected that the new disease would be stopped as readily as cholera, which has in all former years been easily treated. They thought that our measures were cruel, and they were at first opposed to them; but the opposition was not by any means so strong as developed during this year. The people had no idea of the difficulty of dealing with the disease, nor had they any true knowledge of its destructiveness. The first principle on which we based our policy was this, that the disease was epidemic amongst animals as well as human beings; that it was impossible to effectively deal with the disease merely by dealing with human beings or their belongings, but that we should also deal with rats. We observed in September that rats were dying, and from the very beginning we organized a crusade against them. It is a very curious fact that mice are not generally infected. I only know of one case where mice have been infected in numbers and died (and also some birds), and that was in the Pydhownie Police Office in Bombay.

909. Were microbes found in these mice?—No, they all died, and were burned.

910. Were microbes found in the birds?—The birds were not examined. In carrying out the methods of disinfection the great difficulty we usually had was in dealing with the feelings of the people. They thought, for instance, that the destruction of animals, of rats or ants, was not justified by the danger of the disease. Numbers of the people would rather incur the dangers of the disease than destroy certain animals.

911. What classes would these be chiefly?—The classes of people in Mandvi, amongst whom the disease first appeared, were Banniahs, Jains, Bhatias and Brahmans. In the beginning all cases of fever were treated as suspicious and the buildings disinfected and lime-washed. The measures were directed to (1) treatment of the sick, (2) treatment of the articles likely to be infected, and (3) treatment of the buildings. When the sick lived in buildings that were distinctly insanitary, they were removed to the hospitals, but where the buildings were not very insanitary, the sick were allowed to remain. The building was flushed down generally with a solution of phenyle, or permanganate of potash. Perchloride of mercury was also used for flushing places where the sick were, but the chief agents used were creosote preparations.

912. Was permanganate used much?—Yes, for flushing floors, and flushing houses where animals were. We used it very largely by means of steam-engines.

913. (*Dr. Ruffer.*)—What strength was the phenyle?—About 2 per cent. We did not measure as a rule. When used in the steam-engine, it was supposed to be 2 per cent.

914. How was it prepared?—We had tubs. There was a tub from which the steam-engine worked, there were also hand-pumps from the tub.

915. In what proportion did you mix it in the tub?—Two gallons of phenyle to a hundred gallons of water. In

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* Not printed in the Commission's Proceedings.

† See Appendix No. XII in this Volume.

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using these disinfectants on a large scale, we are practically guided by the colour. We cannot in the hurry of work measure it accurately. On the 6th of October a notification was issued by the Commissioner (it is referred to in my report)* specifying the special regulations that were to be carried out. I issued a leaflet (which is also included in my report) telling the people in a popular way the nature of the disease, and what they should do to help us to avoid it. We attach a great deal of importance to the use of disinfectants with force. It has always seemed to me that disinfectants which are sprinkled have not the same effect as disinfectants which are applied from a steam-engine or from a strong hand-pump.

916. Penetration?—Yes, penetration. We never hoped to destroy every microbe, but what we did hope in working with the steam-engine was to alter the food of the microbes, alter the conditions under which they lived. Great attention has been paid to the treatment of grain-stores or shops. They were closed for 20 days and all the articles placed out in the sun and the shops disinfected. Afterwards the period of quarantine, as it might be called, was reduced to three days. In addition to the measures where disease occurred, measures were taken in advance. Tiles were taken off and disinfectants distributed house by house. In the treatment of small buildings in the suburbs, all that was necessary was to take the tiles off the roofs, remove the people and burn any articles likely to be infected. The water supply inside a large number of houses was cut off, and water pipes put outside so as to lessen the dampness inside. Then in addition to this, all the godowns in the Port Trust Estate were emptied. The godowns were disinfected by the Port Trustees and lime-washed, and great quantities of grain sweepings were burnt by us; we also burnt a large number of huts and even chawls in different parts of the town. We made openings over doors, demolished rooms in verandahs and did everything we could to remove obstructions to light and air. The influence of ventilation on the mortality from the disease is very well shown in the following table:—

Table showing the Proportion of Deaths to Attacks from Plague in all Wards and the Water Divisions, from January to December 1897.

Wards.	Ground floor.	First floor.	Second floor.	Third floor.	Fourth floor.	Fifth floor.	Harbour.	Road-side.	Unknown.	TOTAL.
A	72·2	65·8	70·4	57·1	53·8	54·5	66·6	58·6	...	67·8
B	71·1	68·6	59·9	58·9	47·7	33·3	66·6	68·4	...	65·7
C	80·3	78·7	64·8	57·7	42·1	33·3	...	66·6	...	75·6
D	84·7	74·3	58·9	64·2	33·3	...	...	63·1	...	81·5
E	87·5	80·0	77·2	66·6	50·0	40·0	...	50·0	...	84·0
F	93·0	77·7	66·6	100·0	...	...	...	93·3	...	90·8
G	83·6	63·8	63·6	50·0	...	...	...	80·0	...	82·3
Unknown	...	...	...	...	...	...	...	...	100·0	100·0
Water Division	...	...	...	...	...	...	100·0	...	...	100·0
TOTAL	84·7	75·5	67·3	59·7	48·1	45·4	84·6	62·2	100·0	82·6
TOTAL LAST YEAR	74·7	79·0	76·5	68·1	59·0	66·6	...	96·3 85·1		78·1

917. Have you anything else to say?—There are certain buildings and certain classes of people in this city that have, as you may say, almost escaped the disease. Europeans have suffered little; certain of the disreputable classes have escaped, and, as far as I can remember, only one case has occurred amongst lepers. The small proportion of attacks amongst Europeans and amongst other classes who have escaped, excluding lepers, is, I think, entirely due to the ventilation of buildings, the open condition of the buildings in which they live. There does not seem to me to be any other explanation.

918. Has M. Haffkine's prophylactic fluid been used in Bombay?—From the first, we gave all the assistance we could to inoculation. The Municipality gave every assistance to M. Haffkine, and we have done all we could to popularise it.

919. Did you find much difficulty at first?—Yes. There is great difficulty except when the fear of the disease exists. At the same time, I think the dislike to inoculation might be very much lessened by care in the operation. For instance, the popular feeling of the people in regard to the communication of disease from one person to another has to be taken into account. I think it is very essential that after the inoculation of a person, the people standing by, or the people who have to be inoculated, should see the syringe disinfected and be persuaded that there is no danger whatever. Their prejudices should be overcome by always disinfecting the syringe, either in very hot water or in carbolic acid.

920. Done publicly?—Yes. I think one of the strongest causes of opposition is this popular feeling with regard to the blood. The other direction in which, I think, the opposition or the dislike to inoculation may be lessened is in the operation itself. I have noticed that where the injection is slowly performed there is much less local inflammation.

921. Notwithstanding that, there was a great deal of opposition?—The opposition is partly due to prejudice, and partly due to a dislike of the inconvenience caused by the operation itself.

922. Has that disappeared?—It is certainly much less; but there is some want of confidence, and I think that during the next recrudescence a very much larger number of people might come forward for inoculation. During this epidemic the Municipality opened over 50 stations for inoculation.

923. Perhaps you will afterwards give us the statistics in regard to the work of these stations; the numbers inoculated and the results?—We do not know the results yet. Inoculation is like every other measure. If the facilities for inoculation are not always before the people, you cannot expect the people during the panic of an epidemic to make the use of it as they otherwise would. There ought to be facilities in the way of inoculation stations and the people ought to be accustomed to go to them. Unless you have inoculation stations before the epidemic occurs, I do not think you can expect the people to freely use the facilities offered to them. The two chief measures open to us in dealing with plague are inoculation and the removal of healthy people from buildings not only where the disease occurs, but in advance of the disease.

924. The buildings being insanitary?—Not exactly insanitary.

925. But because you expect plague?—Because we expect plague. If, for instance, you have a number of dead rats in a street, with a case of plague at one end of the street, and can possibly remove the people from that portion of the street, or from the building itself, I think you will most certainly lessen the number of cases. There are also some other points. I think the measures ought to be modified according to the type of the disease. There is no evidence, for instance, that the simple glandular form of plague is a very infectious disease: there is no evidence whatever as to that.

926. Will you tell us what your arrangements are at the present time with regard to actual cases of plague?—I would rather not speak of the present time. I advise the Committee with regard to the plague policy, but I am not now in charge of the plague operations. Of course I have been in charge before.

927. Up to what time were you in charge?—I was Chief

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* *Vide* Report on the outbreak of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I.C.S.

Medical Officer of the Plague Committee up to June 1897. And I was in charge from June 1898 up to August.

928. I suppose it has been very much modified since then?—No; the policy has gone back to almost the policy followed in 1896-97.

929. (*Mr. Cumine.*)—Are you not in charge now?—I am not in charge of the operations. The Deputy Commissioner is.

930. (*The President.*)—Can you officially speak as to that?—I see what is being done. It is practically what I have described,—practically the same.

931. With regard to the sick?—Yes.

932 What did you do?—The only difference is that possibly more people are removed to the hospitals, a larger proportion.

933. Is it the policy to remove the people to the hospitals?—The policy is that where people cannot be treated or segregated in their own houses with safety, they are to be removed to the hospitals.

934. You have a large number of hospitals?—Yes, about 30.

935. Supposing you had a case of plague in a house similar to the one of which you showed us a plan, what would be your policy?—In an insanitary house, such as that, or such as you saw yesterday, the policy would be to remove the patient to the hospital. The house would be disinfected. The people might be removed to a camp: in any case they would be removed from the house.

936. Supposing there were a thousand people?—In that case a certain number of the people would be removed to camp and the remainder of the people would be removed from the house. That is the policy.

937. Will you give us some information as to how you segregate the people: they are taken to health camps, are they not?—Yes.

938. Are there many such camps?—There are a certain number of camps, there are several large camps; and smaller camps are being constructed.

939. Their capacity must be very large. You spoke of removing 500 or even a thousand persons in the event of a single person being attacked. What is the accommodation in the segregation camps?—I could not tell you straight off, but over 20,000 people.

940. What treatment do you submit the houses to that you have emptied?—The treatment of an infected place now is to disinfect it with perchloride of mercury.

941. How is that applied?—It is applied from small hand-pumps or pots.

942. What is the strength of the solution used?—1 to 1000.

943. To what part of the house is it applied?—It is applied to every portion of the house in which the patient has been.

944. To the walls, ceiling and floor?—Yes, to the walls, ceiling and floor.

945. In fact the house is inundated with it?—Yes. The whole room is washed out with the solution. In addition to that, the Municipal engine comes and flushes down the galis and the privies. In some cases we flush down the whole building.

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946. If the house you showed me yesterday had to be treated in this way, you would remove everything as being entirely insanitary?—Yes.

947. What would you do with the house?—Assuming a number of cases occurred, the house would in 1896 have been flushed down with the steam-engine and disinfected and the people removed for a short time.

948. Would the people be allowed to return to the insanitary house?—All the people would be turned out, and after a little time they would be allowed to go back.

949. Have you any power to make the owner of the house render it sanitary?—Not only is there power, but a great deal is being done in the improvement of buildings.

950. When the house has been emptied, and before the people who have been exposed to plague are allowed to return to the house, do you not put that house into a sanitary condition?—As a temporary measure, where openings can easily be made, they are made.

951. Suppose you cannot make such openings, would you allow the house to be occupied again, or would you demolish the house?—The house will generally be re-occupied. A report will be made to the Municipal Engineer to improve it, and the Municipal Engineer will improve it in time. Of course in very bad cases people are not allowed to re-occupy the house.

952. Take the case of a house which is a substantial edifice (of which there are a good many examples in the same district) where alterations would no doubt be a serious matter, notwithstanding that you would not, as adviser to the Municipal authorities, give your authority for the return of people to that house until the alterations were made?—No. I would not, but as a matter of fact, the people might return and would unless force was used.

953. What would be the result of your action assuming that you did that?—The result of my action would be that a very large number of people would be without houses, living in the streets or living in verandahs.

954. These people are already accommodated in segregation camps?—Not all.

955. I assume that the camps are made so that there is any amount of segregation space?—I would hardly say "any amount." The amount of segregation space could be enlarged. The accommodation is in excess.

956. There would be no difficulty at the present moment in segregating all the inhabitants of that house should a case of plague occur?—No.

957. Therefore there is no urgency in having these sanitary improvements effected?—That is so one way, but the fact is, unless the improvements are made, the house will be re-occupied.

958. You cannot possibly drive people into the streets. What would be the action of the Municipal authorities if you distinctly advised them that the house should not be occupied until the improvements which you thought necessary had been effected?—The Executive Engineer ought to proceed to improve it. But the exclusion of people from buildings I might condemn can only be effected through force, that is, the police must be used. If you add the pressure of military force to plague measures, the result will be disturbances and the suspension of all measures.

959. The probability is that the house would not be occupied until the improvements had been made?—That might or might not be so.

(Witness withdrew.)

At The Secretariat, Bombay.

FIFTH DAY.

Saturday, December 3rd, 1898.

PRESENT:

PROF. T. R. FRASER, M. D., LL.D., F. R. S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

LIEUTENANT-COLONEL T. S. WEIR, I.M.S., recalled and further examined.

t.-Col. Weir. — Dec. 398. —

960. (*The President.*)—I was asking you some questions with regard to the insanitary condition of the houses affected by plague, and the inhabitants being put into camp?—Yes.

961. And you were telling us of the steps adopted before you allowed the inhabitants to return. I think I have already asked you this. Assuming that there is plenty of camp accommodation, and that a house is obviously and conspicuously in an insanitary condition, what has been your action with regard to allowing the inhabitants to return to that house?—The action has been this. Small improvements that could be carried out have been effected, and a report has been made to the Municipal Executive Engineeer stating that the house was insanitary, and asking him to take measures under the Epidemic Diseases Act to improve it. Small improvements are carried out by Plague Officers themselves.

962. Therefore, you render that house sanitary, wherever you possibly can, before these people are allowed to re-enter?—As far as can practically be done without important structural alterations.

963. Supposing there are important structural alterations, such as in the house of which you showed us a plan, what would you do?—The people would be allowed to return to the house, and a report would be made to the Municipal Engineer as to its sanitary state.

964. What has been the result of that action?—A considerable number of houses have been improved, and improvements are proceeding.

965. I suppose it is impossible to carry out improvements on a large scale at once?—It is not impossible, but it requires men and money. And the displacement of the population has to be considered.

966. It is not practicable?—Practically, it is not possible.

967. I believe that under the projected amendment of the Municipal Act, you acquire very considerably enlarged powers?—Yes.

968. How long have sanitary improvements of dwellings, been carried out on a large scale in Bombay?—The improvement of dwellings has only been carried out on a very large scale since the appearance of the plague. Improvements were being effected undoubtedly as far as the law would permit, but very slowly. In the last 30 years great improvements have been effected.

969. You had not sufficient legal power until the Epidemic Diseases Act, III of 1897, was in force?—That is so. As a matter of fact, we have a little less power under the Municipal Act of 1888, now in force, than we had under the previous Municipal Act. Under the present Municipal Act, the evidence of a Municipal Officer will not be accepted with regard to a nuisance.

970. I apprehend from what you have said that the Act which is being drafted, the amended Act, will give you very ample powers?—Yes.

971. And in your opinion those powers will be perfectly satisfactory?—I think they will be sufficient.

972. Considering the enormous amount of improvement required?—Yes. I should like to reply to a question you put to me yesterday, and to which I could not reply at the moment. Thinking over it, and referring to some of my reports, I think I can answer it now. You asked me what proportion of the buildings in the district you inspected—Kamatipura—were in an insanitary condition: I have come to the conclusion that it would be about 70 per cent.

973. That is a large district, is it not?—Yes. In that district you have some 12 per cent. of the outcast population of Bombay. The district is inhabited by the very poorest of the population.

974. I think you have already given the population of the district?—The population is 29,203. In the adjoining district, where you inspected a house inhabited by Musalman women and weavers, I should put the number of insanitary buildings at even a higher figure. I should put it at not less than 80 per cent. But the people are of a better class. They make better use of their buildings, although the buildings are really insanitary. They have less light and air than in Kamatipura.

975. For a very long time anterior to this epidemic sanitary improvements had not been active?—Not only had they been as active as the law permitted, but we had done and were doing a great deal that was illegal to improve dwellings.

976. I believe you have given much thought to the origin of the plague in Bombay, have you not?—Yes; I have.

977. Would you briefly give us your views?—I have no doubt whatever that the disease was imported into Bombay, but from whence I do not know. It is a mere question of conjecture.

978. What are the suppositions—the conjectures?—My impression is that the disease is endemic in many parts of India.

979. In what parts?—I should say in Kathiawar, in Upper Bengal, and undoubtedly in the Himalayas.

980. Why do you say that?—My reason for saying so is that all Hindu and Musalman practitioners say that this type of disease has frequently been treated by them.

981. A disease having similar symptoms?—Yes, a disease having similar symptoms.

982. I suppose you have questioned them as to what symptoms they meant?—They know the ordinary bubonic symptoms perfectly.

983. Bubo with fever?—Yes, fever with bubo. The disease has been recognised in India by its symptoms for many years,—in the *Tarikh-i-Ferishti* for instance.

984. (*Dr. Ruffer.*)—What is that?—The diary of one of the Indian Emperors.

985. What date?—Over 200 years ago. All over the East the disease is perfectly recognised by people engaged in it. *Taun* is the Arabic name.

986. (*The President.*)—That is your view of the origin?—My impression is that the disease was probably imported into Bombay either by sea or from Upper India; and probably by persons connected with or having access to the granaries, or where grain is stored. The rats become

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infected, the monsoon was abnormal, the failure of the monsoon rains was favourable to the development of rats, and the production of the disease was favoured in that way.

987. You mean, it was introduced by some infected people in the first place?—I am inclined to think that the danger from infected persons of the poorer classes in India has been very much over-estimated.

988. I do not suppose you mean that a rat introduced it, but rather a person?—I am inclined to think that some article had been tainted by a diseased rat.

989. You refer to granaries?—That, of course, is the place.

990. The propagation was due largely to the rats?—Undoubtedly.

991. Not the original introduction?—I think the original introduction may possibly be due to rats.

992. How?—I think in this way. If rats are diseased, the articles on which they pass urine or defæcate are most dangerous articles, and would be most likely to convey the disease.

993. You have no experimental data on that point?—Yes, the evidence collected by the men working here bacteriologically.

994. Which, as far as I recollect, is against that view?—No. The evidence of the German workers is in that direction. The microbes were found in the urine, and also in the dung of rats.

995. But not in sacks or special articles?—As far as I know, microbes have not been found by any reliable worker in sacks, or in gunny bags or on articles. The destructiveness of this disease would be incredible if they were easily found.

996. Was there any history of a large mortality among rats previous to the first epidemic in Bombay?—No. We have had a very high mortality amongst rats caused by grain poisoning. Some years ago, a ship brought in a quantity of wet linseed and other seeds. Notwithstanding our protest, they were landed from this ship and stored in Mandvi, and large numbers of rats died. That is the only instance I remember in Bombay of large numbers of rats dying.

997. Was there any mortality among rats at a reasonable period before this epidemic to associate them in any way with plague in India?—On the contrary, the rat population increased enormously previous to the monsoon of 1896, but I have been told that previous to the appearance of plague dogs, it was observed, that killed rats in Mandvi became ill.

998. With regard to propagation in the town itself, what is your view about that?—My view is this: that the progress of the disease depends chiefly upon the agency of rats and human beings: that the disease is carried by human beings there can be no doubt, but the danger from human beings is not nearly so great as the danger from articles which are inhabited or frequented by rats. I think the danger, for instance, here from the poorer classes is much less than the well-to-do classes. The poorer classes bathe every day in the open air, and their clothes are spread out every day in the open air. If the clothes are infected, the infection is much more likely to be destroyed than amongst classes who have a large quantity of clothes, and who do not expose themselves so much to the air.

999. Supposing we take a house such as I saw: there could not be very effective exposure to air in that place?—The people go into a little open space to bathe, you so saw it. In that house in those rooms the people have nothing except a little loin cloth round them. They wash most of their clothes every day. They hang them out in the air; and the other clothes which are not hung out in the air are hung in the room. To my mind, the danger of infection through these clothes is much less than through bags containing grain, bags in which rats would nestle.

1000. How do these poor people come into contact with bags for carrying grain?—The Banniahs do, and the people generally indirectly. For instance, here not only the epidemics but each of the sporadic movements have proceeded from granaries or from near them. I understand that up-country, in Sholapur (my statement is subject to correction) the disease, by some reliable authorities, was ascribed to the importation of grain from Karachi. The grain was imported from Karachi by a man who had a desire to be charitable; and my information was that the disease was traced to this store of grain.

1001. Karachi being already infected?—Karachi being already infected.

1002. How do you suppose the inhabitants of these poor localities are actually infected through rats: what is the method of infection?—Any opinion I give is merely conjecture: I take the probabilities. I will take that district of Kamatipura. The disease occurred there as though an inoculator were at work. You had a case in a certain house and some days afterwards (perhaps the following day) you had a case two or three houses off; and you may have another case in the same house, while the following day you might have a case further off. It looked as though an inoculator were at work.

1003. Have you anything else to say with regard to the propagation of the disease?—Excluding cases of pneumonic disease (in which the means of infection can be understood), it seems to me that the most probable way in which the disease was often contracted was from abrasions between the toes or the mucous surfaces around the orifices. A large number of people, if you examine their feet, will be found to have abrasions on the soft skin between the toes. There is another fact with regard to the disease. I think the view of associating this disease with dirt, in the sense of refuse, is utterly wrong. As far as I understand, when once the microbe gets into dirt it becomes harmless.

1004. What is your reason for thinking that?—The fact that the classes here who handle dirt and walk in dirt have suffered less than classes who avoid dirt most. I do not see that there can be any other explanation—that microbes when they get into dirt are destroyed by others.

1005. You think the propagation is dependent upon living creatures, such as rats?—That is so, and human beings.

1006. (*Mr. Hewett.*)—You say that you believe that plague is endemic in Kathiawar and Upper Bengal: what do you mean by Upper Bengal?—The valley of the Ganges.

1007. If it were endemic in that locality would you not naturally expect to hear something about it?—I think that because there is a case of plague, the idea that it must become epidemic is an erroneous one.

1008. You say that native practitioners have observed it?—Yes.

1009. Are there as many European practitioners in India generally as native practitioners?—There are much fewer. I think native practitioners are much more numerous than European practitioners.

1010. And they are the people who hold the opinion that plague is endemic in the valley of the Ganges?—They are the people. I have spoken to hakims and vaids.

1011. Is it not remarkable that prior to this outbreak no European Medical Officer has stated that he has seen plague in the plains of India since 1854?—Unless the disease was epidemic, I think it is improbable that a European Medical Officer would recognise that the disease was plague. It was exceedingly improbable.

1012. In spite of the fact that European Medical Officers have seen what many people regard as plague in Kumaun?—The disease has been epidemic during a recent period.

1013. Where?—Jodhpur.

1014. When?—In 1854.

1015. There has been no recorded epidemic on the plains of India since 1854, or more than 40 years before the outbreak in Bombay. If it were endemic would it not be remarkable if it did not come under observation by European Medical Officers?—Certainly.

1016. You know that there have been 14 outbreaks during the same period in Kumaun?—I do not know the exact number. I take another point which I have referred to in this Report.* The disease assumes so many forms that I do not see how the disease can be recognised by medical men unless their suspicions are aroused. You have a form of the disease simulating diarrhœa, and a form simulating cholera.

1017. If that was so, would you not expect Medical Officers to be finding it out in all parts of the country?—Unless the disease is destructive, no.

1018. Mr. Snow, in paragraph 4 of his Report,* says that the first official information of the presence of plague in Bombay reached him on the 23rd September 1896; and in the Report* for the year 1896-97 you mention that two cases occurred on ieut.-Col. '. S. Weir.

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* *Vide* Report on the outbreak of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I.C.S.

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the 21st and 22nd of August 1896: did they come to your notice as Health Officer?—I am not sure as to that.

1019. Did you come to the conclusion that they were cases of plague before Dr. Viegas made his report, or after?—I believed that the disease was plague before Dr. Viegas made his report.

1020. Was action taken on these cases?—We treated it exactly the same as now.

1021. In paragraph 36 of your Report* you speak of a large number of pilgrims from Upper India having passed through Walkeshwar on their way to Nasik. Were they from Kumaun?—I do not know.

1022. What do you mean by "large numbers:" do you mean a thousand or two thousand, or more than that?—Very large numbers passed through.

1023. Where were they located in Bombay?—Round the Walkeshwar temple.

1024. Were they located in Mandvi?—They did not live in Mandvi: they used to go down for grain.

1025. Mandvi is full of large granaries where the ships discharge their cargoes?—Yes.

1026. So that if the plague came to Bombay from the sea, you would expect to find it in Mandvi first?—Yes.

1027. You mentioned as a suspicious circumstance that amongst the pilgrims there were three deaths in August 1896?—Yes.

1028. That would not be many amongst a large body of men?—They died very rapidly. They were sudden deaths.

1029. In your Report* you say, "I have no doubt the cases observed by Dr. Simpson in Calcutta were of bubonic plague." I suppose you know that the Medical Board, presided over by Dr. D. D. Cunningham, investigated the cases, and came to the conclusion that they were not plague?—I have seen Dr. Simpson and I prefer to accept his opinion.

1030. On what grounds?—He saw the disease, and having seen the disease here and studied it, he was exactly of the same opinion.

1031. Dr. Simpson maintains his opinion, but what the Medical Board said was†—"On looking to the evidence as a whole we have no hesitation in expressing our opinion that there is no evidence that any cases of true bubonic plague has yet occurred in Calcutta"?—That is so.

1032 I understand that the plague began some time in the month of August 1896 and that it grew very virulent in the cold weather?—That epidemic commenced about the middle of November.

1033. When did your great exodus of people take place?—In November and December.

1034. How many people left the town?—Some people contend that over 300,000 persons left the town. From that number you must deduct the immense number of people who went into our own suburbs. It has been estimated that 100,000 people settled in F and G Ward.

1035. The course of the disease was that it began to decline again when the hot weather came on?—Yes, in March.

1036. And then it rose again in the autumn?—In June and July.

1037. Did it follow the same course in the second outbreak?—It commenced in the middle of December and it reached its maximum in April this year. Its commencement was a month later, and its fastigium two months later.

1038. During this outbreak, which was a severe one, the population remained in Bombay?—Yes.

1039. When the people ceased to be frightened they return in large numbers to Bombay?—The people commenced to return to Bombay in February 1897: I am not sure that they did not commence to return before that.

1040. They came back both by sea and by rail?—Yes.

1041. What were the arrangements made to deal with any possibility of Bombay becoming re-infected?—There was harbour inspection, and also inspection on the railway lines.

1042. Do you think that the larger number of people that brought back infection came by sea or by land?—By land.

1043. You put them in segregation camps when they came here?—No, only those who were diseased.

1044. So that those persons in whom the disease was incubating were not restrained in any way when they returned?—No.

1045. The disease has never been actually stamped out in Bombay, but has continued to smoulder all the time so that the city has never been free for ten days since the first infection?—It was not free for any time.

1046. You have no search parties at work now?—There are no search parties; but the Plague Officers are always engaged.

1047. But you have committees of the natives of the place who help the officials employed on plague duty?—Yes.

1048. And they report to the Plague Officers?—Yes.

1049. If a Plague Officer has reason to believe that they are not reporting fully, does he take the matter into his own hands?—Yes. As a matter of fact, the Plague Officer is a check upon the Committee, and the Committees are a check upon the Plague Officer.

1050. Do you think that cases are now concealed much?—There is a very small amount of concealment. The real difficulty is the recognition of the disease.

1051. The people do not wish to conceal it as much as they did?—No.

1052. To what do you attribute that change of attitude?—I attribute it to two causes. The cases are fewer, and the irritation caused by the measures does not exist. The people are in a much better temper, and there is a certain discretion in regard to segregation of people.

1053. If the disease were to increase again, do you think that concealment would begin again?—It depends to some extent on the measures; but when an epidemic occurs, there is irritation caused by the disease among the people. People lose their relatives, business is ruined, and the people naturally become irritable and sulky.

1054. Do you think that it will be possible to obtain a more accurate record in future of those cases?—I do not think you can do more in the future.

1055. What proportion of concealed cases were there during the epidemic?—It is difficult to say.

1056. What is the proportion approximately?—In 1898 I gave a return. I gathered that 100 cases at one time must have been concealed in one day.

1057. I suppose it would be unusual to have so many cases concealed in one day?—It was at the height of the epidemic.

1058. There must be a limit to the number that can be concealed?—There is total concealment and partial concealment.

1059. Do you think that inoculation is useful and that it will become a popular remedy?—I think it is a most useful remedy, but that it will become popular I can only hope. The popularity of such a measure greatly depends on the sentiment at the time of the people.

1060. But is it likely to be generally utilised before the plague begins?—I do not think it is likely to be made general use of until an epidemic occurs.

1061. Then do you regard your other remedy, evacuation of houses, as the real remedy?—Yes, the removal of healthy people. I do not look upon the removal of sick people from a house as so important as the removal of healthy people.

1062. You believe in evacuating not only infected houses, but other houses?—The policy is absolutely sound.

1063. Has the evacuation of infected houses been continuously carried out in Bombay?—Yes, it has.

1064. Without exception?—Yes, without exception, from the very beginning.

1065. The whole house has been evacuated?—I am speaking of what has occurred. It has not always been done, but the general policy has been not only the evacuation of the house infected, but very often the evacuation of the adjoining houses.

1066. Would you insist upon the evacuation of houses by Europeans?—I do not know whether you have seen the correspondence I had with General Gatacre. It is in my Report.* I look upon some bungalows as dangerous.

1067. Would you say that it is necessary for a European to evacuate his house?—No; if the house was a good one.

1068. Would you say that it is necessary that a native should evacuate his house if he belongs to a superior class and has a superior house?—No, it depends upon ventilation.

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* *Vide* Report on the outbreak of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I.C.S.

† See Appendix No. XXI in this Volume.

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1069. If he has a good house, might a portion of it be utilised as a hospital?—I think so.

1070. Is that done in Bombay?—That is done, practically.

1071. That relieves irritation and is equally effective?—Yes; not only that, but I say, as it diminishes the amount of concealment, it is likely to be more effective.

1072. What is the percentage of the total population in Bombay of persons living in chawls?—I could not tell.

1073. Does it amount to half?—More than that.

1074. I think it is officially stated somewhere to be 70 per cent?—It is guess-work.

1075. Do you think that you cannot allow the occupants of chawls to remain in their houses?—On the contrary, I think chawls are infinitely better than some houses in the suburbs.

1076. Why?—Because where you have a chawl with a gali on either side you have a room which has a certain amount of air through it; but if you have one of the old houses in the suburbs or town, you have inner rooms which have no percolation of air.

1077. Do you think that there are numbers of chawls in which sick persons can be left without objection?—I think so undoubtedly.

1078. Have people been allowed to remain in them?—Yes.

1079. Without any evil results?—Last evening you were round with us in Mazagaon, and you saw a woman in a chawl.

1080. But had not that chawl been re-infected three times?—The last chawl you saw we went upstairs. That, I should say, was not a suitable place. When a chawl has a verandah, I can see no reason why the sick should not be treated in the verandah; and if there is an open space in front, I can see no reason why an awning should not be put up, and a little hospital formed.

1081. Can you tell us how many people you can accommodate in the segregation camps?—There is actual accomodation today for 7,700 people. It can easily be increased to 20,000.

1082. That is only a fraction of the people you may have to turn out of their houses in an epidemic?—In the evacuation of houses, you must not confine your evacuation to the removal of people to camps.

1083. You would not have to turn a great many more than 20,000 out of their houses?—You would have to turn out a very much larger number than 20,000.

1084. What are you going to do with them?—I should allow them to shift for themselves. They go into verandahs, passages, other houses, and open spaces.

1085. Is it an effective precaution to put them into segregation camps and to allow them to leave during the course of the day, but to require them to return to the camp at night?—That would be an effective precaution, assuming that the house where they had been living contained rats that have the disease. It is the removal of persons from places where they may be infected to places where they are not likely to be infected.

1086. That is the reason you would allow them to go to another place, which need not necessarily be a segregation camp?—This year over 500 people have come in from a very infected village called Danda outside Bombay. Some settled in the north of the Island, and others in different places. I asked the Police to assist us, and I believe they were all removed outside Bombay by force. Curiously, not a case occurred amongst these people from Danda, nor did we trace cases to them.

1087. Do you think that it would be possible to take contacts by train and put them into camp at a distance?—It is possible. I should say let the people help themselves as much as possible.

1088. Does the physical configuration of Bombay render it difficult to segregate more than a small proportion of the population?—Yes; and there is this difficulty,—that you have over 100,000 people who come here to earn a daily wage.

1089. Do they leave the town every day, or are they mill hands living in the town?—Many of them live in the town.

1090. Was it a practice of General Gatacre's Committee to mark houses which they regarded as uninhabitable with the letters "U. H. H.,"—"Unfit for Human Habitation"?—That system of treating houses was adopted after General Gatacre went away.

1091. Is it still in operation?—Yes.

1092. People are not allowed to go back to those houses?—No, they are discouraged.

1093. In a large number of instances you have pulled the houses down?—Yes.

1094. And you have removed the tiles from a large number of houses?—Yes.

1095. With what object?—To let in air and light.

1096. Have you taken up the floors in a number of cases?—Yes.

1097. With what object?—To expose the soil to the air in case it did contain infection.

1098. You have altered a number of houses in order to improve the ventilation?—Yes.

1099. I suppose the Municipal Engineer can give us details as to what has been done in that way?—Yes.

1100. You spoke of some alteration of the law: did you refer to the projected alteration of the Municipal Act, or the law that has been passed to allow the re-building of certain portions of Bombay (The City of Bombay Improvement Trust Act, IV of 1898)?—I referred to the draft Municipal Act.

1101. Has the Bombay Government in hand a system or scheme for re-building the worst parts of Bombay at a cost of a large sum of money—about four crores of rupees?—It is estimated to cost that, and it will probably cost very much more.

1102. The Act has been passed, and a beginning is about to be made?—Yes.

1103. I suppose you think that is the best measure of reform that could be taken to prevent plague attacking the town in future?—I think it is the very best measure that could be adopted with a view to reducing the mortality from plague.

1104. So long as the houses are such as they are at present you will necessarily have to allow people to go back to houses which you do not regard as sanitarily perfect?—In the fair weather there is no doubt that the people of Bombay could shift for themselves: they could distribute themselves over a large number of houses and open ground.

1105. You let them go back to houses which you do not consider altogether sanitary?—I should say we are obliged to do that. It would cause the people great inconvenience if we did not.

1106. You said you considered a large proportion of houses in certain wards to be insanitary: where are the people to go to if you turn them out of their houses permanently?—In Bombay there is a great capacity for activity in house construction. I believe if communications were opened up in the north of the island, the local builders would provide for the population in a very short time.

1107. But the accommodation does not actually exist?—No.

1108. You might have to turn them out in the rains, and they would have to suffer every discomfort?—Yes.

1109. Therefore you are compelled to allow houses to be occupied at present which you cannot regard absolutely as perfectly sanitary?—We are compelled in this way, that if we turn people out and refuse to allow them to return, they would probably feel it and resent it and oppose us.

1110. Where would they go to?—To verandahs of other buildings or open ground or other buildings. It would increase the overcrowding in other parts of the town. I think you would find buildings rapidly put up in the suburbs.

1111. (*The President.*)—Within what time?—I could not say. In a couple of months some big chawls might be put up.

1112. Before the rainy season?—Yes.

1113. (*Mr. Hewett.*)—But supposing that the outbreak were worst in the hot season, could you prepare them before that?—The plague has declined in the hot season.

1114. I am speaking of February, March, April and May, those four months?—The progress during the last few years has been gradual.

1115. (*Dr. Ruffer.*)—You have given some interesting statistics about the number of deaths, cases, and so on, in the City of Bombay. How are those figures arrived at: for instance, what is the system of registration of deaths in Bombay at the present moment,—and what was the system in force at the beginning of the epidemic?—The system is exactly the same now. There has been no alteration in the system. The information, under the Municipal Act, is obtained at the cemeteries. At the principal cemeteries

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there are men with qualifications to whom the people who accompany the dead bodies give the information specified under the Municipal Act. These Registering Officers enter the information in a book or register from which the death reports are prepared. In addition to that under the Municipal Act the medical men are bound to report cases of infectious diseases.

1116. Does the information you have as to the deaths come from the relatives of the patients?—Yes.

1117. What about the diagnosis of the case?—That comes from the relatives too, unless when a medical certificate is furnished.

1118. Are you then practically dependent on the relatives for the diagnosis of the case?—Undoubtedly.

1119. Does the medical man in charge of the cemetery examine the body?—Not always.

1120. When does he examine it?—As a matter of fact until the examination of dead bodies excited some opposition, whenever a medical man had a doubt as to the statements made by the people who accompanied the dead bodies, he examined the bodies; but for some time, owing to the opposition caused by it, the system has been abandoned.

1121. So that at the beginning of the epidemic, for instance, in the months of August or July, as a matter of fact no bodies were examined?—Unless the medical man had a very strong suspicion. Then he would examine the body or give information to the police.

1122. Are the bodies examined now?—No.

1123. So that you are still dependant for your information upon the words of the relatives?—Yes; and on information supplied by medical men. But fewer people are now attended by medical men than in 1896 at the beginning of the epidemic. In 1898 the people almost ceased to call in medical men to see cases of fever.

1124. There are several cemeteries, and you would have medical men at them; for instance, at the Parsees' Cemetery—the Towers of Silence,—would you have a Parsee gentleman to examine bodies?—At the Towers of Silence there is no medical man.

1125. How do you know what a person brought there died of?—A very large proportion of the Parsee population are attended by medical men.

1126. But there is no system of death certificates?—No. But very often a medical man will send a note with the funeral party stating that he attended "so and so," and the cause of death, etc.

1127. Supposing he does not do that?—All that can be done is to accept the statements of the relatives.

1128. Do you think the statements of the relatives, as a rule, are to be trusted?—I do not think so. They themselves do not always know the cause of death.

1129. So that I take it there is practically no system of examination of the dead at the present moment?—No.

1130. And no such thing as a death certificate?—There is from the medical man.

1131. But it is not compulsory?—It is compulsory in the case of epidemic diseases.

1132. What is the proportion of cases of epidemic disease visited by medical men, leaving plague out of the question?—Very small. Previous to the appearance of plague in Bombay, I do not think 10 per cent. of all dying were attended by medical men.

1133. So that in practically 90 per cent. you have no medical certificate, and no knowledge of the cause of death except the statements made by the relatives?—That is so.

1134. (*Mr. Hewett.*)—In the event of there being a doubt as to the disease from which a person died,—that is to say if you cannot get satisfactory evidence from the relatives, is it your practice to draw the presumption that it was a case of death from plague?—That would be the presumption during an epidemic. It is the practice now. I should like to mention that after death reports are received in our office, they are sent out to the different sections, to the medical men to make enquiries; and the medical men make enquiries from the relatives and from the people living in the houses where deaths have occurred. The death reports are corrected finally from the reports of the Medical Officers.

1135. It would not be possible, would it, to discern the pulmonary species of plague by a summary examination of the corpse?—I do not think it would.

1136. Would anything but a summary examination be resented from a religious point of view?—Undoubtedly. Anything but a summary examination of corpses in the city is impossible.

1137. (*Dr. Ruffer.*)—You say that the statistics are corrected according to the reports of the medical men?—Yes.

1138. But these reports of the medical men are based upon enquiries from friends?—And from people living in the houses.

1139. So that practically it comes to this, that it is the statement of the friends upon which you base your statistics?—They are also corrected by the incidence of deaths. For instance, where you have two or three deaths in one house, however much the relatives may protest that the disease was not plague, you continue your enquiries to establish the fair suspicion caused by the number of cases.

1140. Finally, it always comes to this: in the majority of cases you have only the evidence of friends to go upon, corrected, more or less, by the examination of the medical officer?—Yes.

1141. Is it not a fact that among the cases which have been sent into the hospitals as plague a great many other diseases, such as relapsing fever, and other cases, have been included — even two cases of hysteria have been mentioned by the German Commissioner?—Some cases must be necessarily included.

1142. And these cases were examined by the medical officer?—Yes.

1143. So that there is a likelihood of a man's making a mistake, if the medical officers even make mistakes?—Undoubtedly some mistakes have occurred and some must occur.

1144. Could you tell us what your medical and disinfecting staff under your orders was at the beginning of the plague; we will say in July or August 1896?—As a matter of fact we had no medical staff. When an epidemic commenced our system was to employ medical men.

1145. In August 1896 you were the only Medical Officer of Health in Bombay?—That is so.

1146. You had no District Medical Officers?—No.

1147. What was the disinfecting staff and apparatus at your disposal at the beginning of the epidemic?—We had fire engines for discharging disinfectants and specially for flushing buildings, and hand pumps,—English and wooden Chinese pumps.

1148. No stoves?—No.

1149. Any specially trained disinfecting staff?—The whole Health Department Staff themselves were always engaged in disinfection.

1150. What was the number of your disinfecting staff?—We had no disinfecting staff set apart. Where cases occurred, men were drawn from the ordinary staff.

1151. Had these men received special training in this disinfection?—They had all been instructed in the detail of disinfection.

1152. What was the number of these men?—No men were set apart. There was a Sub-Inspector of a Section, and when a case occurred he drew men from the section staff and supervised them.

1153. He had been specially trained for it?—He had been trained in disinfection.

1154. Mr. Hewett has asked most of the questions I was going to ask as to the origin of the plague in Bombay City. As far as I can make out (I am open to correction) the first case occurred in August?—The first probable case.

1155. But it was not until the 9th of October that the Municipality took steps to enforce segregation, or even passed a resolution concerning segregation?—The Commissioner issued his notification on the 6th of October.

1156. During that time what measures were taken?—Exactly the same measures of disinfection that were adopted afterwards. The place was disinfected. And after two years we see that the policy of dealing with plague has gone back the measures adopted in the very beginning by the Health Department. The disinfection is less drastic perhaps now. As a matter of fact, nearly all the cases that came under our notice in August and the beginning of September were cases that were found after death. There was no information with regard to the cases during life.

1157. You spoke of an endemic centre in the Himalayas. I do not know exactly the distance of the Himalayas from Bombay, but you have not been able to trace any case extending from the Himalayas to Bombay?—No but I have referred to suspicious cases from Upper India in my Plague Report.*

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* *Vide* Report on the outbreak of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I.C.S.

1158. You have no knowledge of a man from the Himalayas bringing a case to Bombay ?—Speaking from memory, I have some idea that, previously to the appearance of plague in Bombay, a case like plague was reported near Burdwan.

1159. Is it not a fact that there are centres in a great many mountainous districts,—at any rate in three, at the very least, in the Himalayas, in Assyr, and also in Uganda—and that the disease had not spread from these places ?—Yes ; and on the frontiers of Persia also.

1160. So that the fact that there is an endemic centre in the Himalayas would not necessarily show that plague came from there ?—No.

1161. You spoke about native practitioners having some knowledge of cases in which buboes occur and cases of high fever : is it not a fact that in a great many cases of malaria you do get enlarged glands like buboes ?—That is what makes the recognition of plague in the first instance so difficult.

1162. But do you not think that these cases described by native practitioners may not be cases of plague, but malaria with enlarged glands ?—Possibly ; but I think it is a question whether glandular fever (as we have been accustomed to look upon it) is not really modified plague.

1163. Is is not a fact that there was a case on board a steamer as to which there was a great deal of doubt, and that it was ultimately found to be a case of malarial buboes ? —Possibly.

1164. You have no knowledge of that ?—I think I saw a reference to that case in the papers. A case was reported in my Report * on plague in 1896 of a European returning to Bombay after being away in England for six months. He was treated on board ship for simple glandular fever. After his arival in Bombay he was treated by different medical men, one of whom was Professor Childe. There was a difference of opinion amongst medical men, but Dr. Childe came to the conclusion that it was a case of plague.

1165. You are not a great believer in the communication of the disease from one human being to another ?—I believe in it undoubtedly ; but I am of opinion that the spread of this epidemic through human agency has been exaggerated. Nobody who knows anything of the disease can doubt that it can be communicated from one human being to another. I think there is a great deal of evidence to show that the simple glandular form of the disease is practically not dangerous.

1166. In paragraph 274 of your Report * of 1896-97 you say, " Believing that the disease might be communicated through excretions from the sufferer, we treated first down-take-pipes or channels from the place where the sufferer was, and then the privies ". What excretions do you mean ? —That statement, I believe, has not been supported by further information.

1167. You do not believe now in the possibility of excreta being contagious ?—Excreta ought to be treated.

1168. You lay great stress upon the communication of the disease by rats in the beginning of your Report,* and you give the dates on which the disease appeared in various places round Bombay ?—Yes.

1169. In any of these places, could you point to a specific instance where the disease was to a certainty carried to that place by rats ?—No, not one.

1170. You could not exclude human agency in any of these cases ?—Not at that particular time ; but at a subsequent time there is evidence that rats migrated across the Bandra Causeway. It is not referred to in my report, but it is referred to in Mr. Logan's Report.†

1171. Where is Bandra ?—Beyond the Causeway.

1172. How are the two connected ?—By a road and a bridge : they are separated by a creek.

1173. If rats come across, a man could come across ? —Undoubtedly.

1174. In the districts mentioned in your report * was it established that there had been one or two sporadic cases before the mortality amongst the rats was noticed ?—I do not know that that has been established. The information with regard to sporadic cases is most uncertain. You can never rely upon it.

1175. In the case of Bombay itself, the disease certainly appeared in August if not in July : you yourself mentioned cases which appeared in August ?—But there is no evidence that it was epidemic.

1176. We will call it sporadic. There were cases of plague in August : when was the mortality amongst rats noticed ?—In September.

1177. When the mortality amongst rats was noticed in certain districts had not cases of plague probably already got into these districts ?—In the very beginning there was a migration of people, but the epidemic did not follow the migration of people.

1178. Therefore there was some chance of rats being infected as well as men by cases of plague ?—Yes.

1179. Is it not possible that the incubation period among rats may be shorter than amongst human beings or *vice versa* ; and is it not possible that an epidemic among rats may proceed much more quickly than among human beings ?—That is quite possible.

1180. Have you any authentic case in which you can prove that a human being or a locality was infected from rats from which you can exclude the agency of man ?—It is difficult when you have cases occurring in town. A case has occurred in Sion (it was reported yesterday to me) in which absolutely no connection with any other case could be traced. I have here the report of one of the medical officers. It is with regard to the case of plague in a house following on the appearance of dead rats ; but it is impossible to say that the people were not exposed to contagion or infection from human beings. This is the report :—

Bombay, 29th November 1898.

To

Lt.-Col. T. S. Weir, I. M. S.,
Health Officer, Bombay.

MEMO.

With reference to the verbal information given by me to-day noon regarding a plague case occurring in house No. 31-33, Gola Lane, Fort, I have the honor to send the following report as required by you.

One of the inmates having reported that dead rats were found in the house, I visited the place and ascertained that some half-a-dozen rats were found dead on the second floor on the 24th instant, and that it was only then that they found that three more were also found on the first floor, about the 19th, but an old lady on the floor (the one who is suffering now from plague) not understanding their significance and the danger incurred in handling them, threw them away herself and informed nobody of the fact. The inmates of the house were advised to leave it and go into camp which they did leaving, however, three persons, including the old lady above-mentioned on the first floor, who handled the rats. Last night this old lady, named Pirojbai Nusserwanji Boochia, age 60, was attacked with plague, *i. e.*, about ten days after dead rats were first found in the house. Those in the camp and two others in the house are not attacked up to date.

(Sd.) K. C. Malagamvala,
Dy. Health Officer,
A Ward.

1181. In your Report * you spoke of one case of plague having been communicated by a rat-bite ?—Yes ; it was reported by Dr. McCabe Dallas.

1182. I should like to have the particulars ?—I will look them up.

1183. (*The President.*)—Can you get a report from this gentleman ?—Dr. McCabe-Dallas is not here.

1184. Where is he ?—I do not know. He was our medical officer for some time : he was also in charge of the Grant Road Hospital.

1185. Is he in India ?—I think he is on a tea-plantation.

1186. It would be better to get his own report, if possible ? —We may have that report in our office.‡

1187. (*Dr. Ruffer.*)—With regard to pigeons and cats mentioned in your Report,* have you any evidence to show that they were infected with plague, or was the mortality merely a coincidence ?—The only evidence we have is that they were either sick or dead.

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* *Vide* Report on the outbreak of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I.C.S.

† Published in the Account of Plague Administration in the Bombay Presidency from September 1896 till May 1897 prepared by M. E. Couchman, Esq., I.C.S

‡ See below record of witness' re-examination on 17th March 1899.

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1188. You have no evidence to show that they actually had plague ?—No.

1189. In your Report,* page 58, paragraphs 114, 115, 116 and 117, you give some extremely interesting cases of importation of plague by sea. In paragraph 114 you say :—"Two very interesting cases were imported by sea. One case, a steward, who came direct in the steamer from Suez, landed suffering from slight fever ; but afterwards the characteristic symptoms of bubonic plague appeared with enlargement of the glands on the right side of the neck. Temperature 105, respiration 55, at time of admission. The steamer had touched at no places between Suez and Bombay"?—That is so.

1190. Then there are three more cases mentioned in the other paragraphs.* Could you give us some information about those cases, or a reference to where we could find the details ?—I will look them up.†

1191. They are extremly important, especially one, which seems to have been on a ship which had never been to Bombay at all ?—I will look it up. With regard to the importation of disease by sea, in September 1896, I made enquiries from the P. & O. Co., and other lines, as to whether dead rats had been seen on board their ships ; and the reply was in the negative.

1192. In your report you speak about the difficulty of obtaining information of cases before death. I suppose that probably accounts for the difference in mortality between the cases in the hospitals, and the total mortality ?—I think so undoubtedly, because there are a certain number of mild cases that would escape official recognition and registration.

1193. The same difficulty would apply to finding out where the hospital patients came from ?—Undoubtedly. There is a great difficulty in many cases.

1194. So that supposing you could not find where the patients you have had in the hospitals came from, you could not segregate their friends ?—Possibly not.

1195. Have a great many escaped segregation ?—Undoubtedly.

1196. You fix the time during which houses should be evacuated to 20 days, but I do not gather why you fix that date ?—That was in the case of godowns, not houses. It was simply an arbitrary rule. It was merely this : it was a period within which we thought it was probable that all the rats in the place would die or would leave, and give a certain margin for disinfection, and a certain time for the action of the air.

1197. You have no special reason for fixing that date ?—No ; but as a matter of fact the period was afterwards reduced to three days.

1198. In paragraph 113* you fix the period of incubation. You say "the period of incubation in some cases appeared to be under two days." Can you give any definite facts ?—Yes, I think so.

1199. Perhaps you will add them to your evidence ?—I will do so. Speaking from memory, there are cases of people arriving in Bombay, and suffering from the disease within twenty-four hours of their arrival.†

1200. In paragraph 721* you state, "From the 11th of March to the 31st of May, as many as 1,073 cases occurred in this district, notwithstanding that segregation was as well carried out as it could have been." Has that been your experience, that as large a number as that escaped from one district in spite of segregation ? Do you find, as a matter of fact, that a large number of cases occurs amongst segregated people ?—A large number of cases do not occur among segregated people.

1201. They occur outside among people who have not been segregated ?—Undoubtedly. I mean, although segregation was carried out as well as could be, still the disease continued to progress to the extent represented by 1,073 cases. That is what I mean by that paragraph.

1202. Not in the segregation camps ?—No. That was the total number of cases detected in the district.

1203. A certain number of people do not get to the segregation camp ?—Just so.

1204. Where do they go to ?—Into other houses, or into verandahs, or open land at this time of the year.

1205. If these people do not go to segregation camps, but go into other houses, are they not likely to carry disease into those other houses ?—One would think so undoubtedly : yet the number of cases that could be traced to people from houses that were infected has been very small in Bombay.

1206. At the same time in your Report* you say that it is not known where a great many cases in hospital come from ?—That is so.

1207. So that the evidence is not quite conclusive upon that point ?—No, it is not.

1208. Would you have any objection to disinfecting a house and allowing the people who have evacuated it to go back to that house after disinfection ?—It is desirable to allow an interval of a couple of days.

1209. You are more a believer in natural disinfection than artificial ?—I believe in both ; but you cannot be sure you are safe.

1210. You said in your Report* that you disinfected the floors and the walls by means of pressure and pumps—by disinfecting solutions: do you think that it is possible to disinfect a wall by washing it with a disinfecting solution : have you any experiments bearing upon that point ?—Of course, all disinfection in that way is liable to fail in cases undoubtedly. But I think when you apply any fluid, even this water, to the wall of a room and displace the covering, you alter the condition under which the microbe lives, and the organism is killed. Disinfectants must be applied with force.

1211. You have had cases occurring in houses which had been disinfected ?—Undoubtedly.

1212. And cases, also when you had lime-washed the rooms ?—Yes.

1213. How was the lime-washing done ?—We used strong quicklime.

1214. Inside and outside ?—At first we lime-washed the inside and the outside, and afterwards only the inside. The lime-washing was gradually reduced to limewashing the place where a case occurred. We lime-washed in 1896-97 in Kamatipura not only where the disease occurred, but street by street, altogether in advance of the disease. I studied up the statistics, and, as far as I could see, the lime-washing had no effect. They are given in detail in my Plague Report.*

1215. Among the things which you used for disinfecting floors, did you use a solution of corrosive sublimate, 1 in 1,000 ?—Yes.

1216. Have you noticed the experiment of Mr. Hankin which tends to show that a solution of corrosive sublimate 1 in 1,000, applied to floors, rather increases the number of microbes in the soil : you do not think those experiments are correct ?—I think all experiments must be repeated. I think for practical purposes you must put experiments aside unless they are repeated and checked. Mr. Hankin's experiments were confirmed by our practical experience, as from the beginning we had observed that permanganate of potass was the most useful disinfectant for buildings with earth floors. I have no doubt of the accuracy of the experiments, they confirmed what we had done from the first; they were very valuable.

1217. In a large number of cases you removed the tiles from the houses ?—Yes.

1218. Do you find, as a matter of fact, that the removal of the tiles from a house prevents a recurrence of plague in that house ?—Yes. I think it diminishes a recurrence of the plague.

1219. Can you give definite facts bearing on the point ?—By looking at the statistics.

1220. Comparing houses from which you had removed tiles with others ?—It acts not only in the way of admitting light and air but it drives rats away from the roof. It acts in that way as well as giving light and air.

1221. But there is room for rats to run about when the tiles are off ?—The openings frighten them away.

1222. I see in your Report* that in some cases you cut off the water-supply because you believed undue moisture favoured plague ?—Yes.

1223. Have you any definite facts bearing upon that point, or is it simply an impression ?—We have statistics but the statistics do not show that the cutting off of the water-supply has really much influenced the recurrence of cases.

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* *Vide* Report on the outbreak of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I.C.S.

† See below record of witness' re-examination on 17th March 1899.

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1224. So that perhaps you have not the same opinion now?—I have exactly the same opinion, because I think one must be very careful indeed in drawing conclusions with regard to plague. If statistics conflict with well-known experience, I think, they must be put aside.

1225. I also see that you sprinkle chloride of lime on the floor and passages?—Yes.

1226. Have you any reason for preferring dry chloride of lime to a solution?—I prefer everything dry in Bombay, because there is so much moisture.

1227. You also use carbolic acid powder. How much carbolic acid does it contain?—Fifteen per cent. of carbolic acid.

1228. That is also used dry?—Yes, very largely.

1229. In your Report,* there is a most interesting paragraph on the recurrence of cases. At page 170 you quote three cases in which people had plague twice. I should like to ask you this with regard to the second case. You say the first attack was on the 30th of September 1896; on the 15th of November the case had no fever, the buboes suppurated, and the pulse was 112. Then you say there was a recurrence on the 2nd of December. Was that the 2nd of December 1896 or 1897?—The 2nd of December 1896.

1230. If the man has still a suppurating bubo on the 15th of November, do you not think that the case might be more fitly described as a relapse?—Do you think so? Possibly.

1231. On the 15th of November, that is, 17 days before the recurrence took place, he had a suppurating bubo?—It is not stated here whether the bubo had healed. I must look up the original reports.

1232. I suppose since that time you have had no other cases of plague occurring twice in the same person?—I made enquiries with regard to the case about which you ask for some information. We have the information but I cannot recollect it. I have sent out a circular to medical men asking for information with regard to the recurrence of cases. When I get the necessary information, I will send it in.

1233. (*Prof. Wright.*)—With regard to the measures you took for the prevention of plague, you use antiseptics: did you not depend upon experiments to tell you the strength?—No, not at all: far from it, we could not wait.

1234. Dr. Ruffer asked you something about Mr. Hankin's experiments. Do you guide yourself by those experiments in fixing the strength of your antiseptic?—Where experiments of any kind conflict with our well-known experience, I should like to have those experiments repeated.

1235. You have spoken about statistics—do you then guide yourself by statistics?—Statistics must be supported by experience. When plague broke out there was a popular impression, supported by statistics, that the epidemic was due to the state of our sewers. Statistics were produced to the effect that it was so. It was very difficult to refuse those statistics at first.

1236. What steps then do you take to ascertain that your measures are useful? How soon will you have a report showing that the untiling of the houses does good or harm? You wash the houses, and then you tell us that the dirtiest classes are not subject to plague, and still you go on cleaning the houses after having arrived at the opinion that plague microbes die in dirt. I want to know what tests have been applied. If you untile the houses, what tests do you propose to apply? Are you making a census of the incidence of plague in untiled houses and in houses that are still tiled?—We have not a census of the houses that were untiled in 1896 or 1897, because the panic that occurred at that time prevented us from taking one. There is no stronger evidence of the value of letting in air and light than the escape of European masters so frequently while their servants have suffered—the escape of all who live in open places. The statistics of the mortality by class exhibit it.

1237. On what principle do you untile a place: I notice that some houses are untiled and others are left?—We only commenced after the rains to let in sun and air.

1238. Do you intend to untile every house?—Every house we can.

1239. How do you take them?—According to the class of people.

1240. That is to say, you untile all the smaller houses?—Small houses, and houses occupied by the poorest classes. We hope this Commission will assist us to form an opinion with regard to the matter.

1241. We want to know what means you are taking. But one wants to know also how these things are afterwards tested by experience. You attribute a great deal of importance to rats?—Yes.

1242. Might not a ship take on a cargo of rats by going alongside wharves?—Yes.

1243. Do you as a matter of fact find that the fact that a ship has gone alongside the wharves influences the occurrence of plague on board?—All I can say is that the number of cases which have occurred on board ships is small; but I think it is an undoubted danger.

1244. Do you poison the rats?—We poison them and catch them in traps. The poison, however, after a time is not taken. They become very wary. When once there is disease amongst rats, they are are very wary and commence to migrate.

1245. You segregate a certain number of people subject to the infection of plague. By what means do you test that to find out whether it is effectual or not? Have you got any comparative statistics of the incidence of plague among the segregated and non-segregated?—Yes.

1246. What is the proportion of plague cases to the total number of segregated?—The proportion amongst the segregated is very small indeed.

1247. How does the incidence of plague among the segregated compare with the general incidence of plague among the people; do you, as a matter of fact, segregate those who are most liable to infection? Have you any statistics bearing upon that?—Yes.

1248. Do you happen to know whether the proportion of plague cases among the segregated cases is larger than the proportion among the total population?—The proportion is very much smaller.

1249. Then they ought not to be segregated, because they are less liable to get plague. You segregate people, do you not, on the assumption that they are more liable to develope plague?—No, not for that reason only; we segregate people who are in a position in which they are likely to catch the disease. We try to save people from plague.

1250. Why should you segregate them?—We remove them from the places—to escape the bacillus.

1251. Why not put them into other houses?—Of course that was our policy originally. One objection to removing them to other suitable houses is this, that amongst them there may be some people who are suffering from the disease.

1252. To know whether they are more infective than the rest of the population, you must have statistics to show that segregated people are more likely to get plague than non-segregated people. You can drive them into other houses or put them into segregation camps, but there is no justification in putting them into segregation camps, unless you know they are more likely to develope plague than others?—There may be persons among them suffering from the disease and you remove them from the place infected and from near the rats infected.

1253. Anyone in the town may be suffering from the disease?—I do not think that is so. A person who is living in a district in which cases have not occurred is not as likely to suffer from the disease as a person living in a district in which the disease has occurred.

1254. That is theoretical, I quite agree, but we want to test that theory by experience. Can you produce statistics?—Certainly.

1255. You said you take measures in advance of the plague. How do you know where the cat is going to jump?—Supposing you have plague in one house, how do you know where it is going to jump to?—Take Kamatipura; we proceeded street by street. We did not know to which house it was going, but we knew it was going to a certain locality. I am speaking of 1896 and 1897.

1256. You do not adopt those measures now?—Except with regard to taking off the tiles, we proceed in advance of the disease.

1257. How do you know where the disease is going to advance?—You can tell by localities. You can pretty well line out the probable advance of the disease.

1258. What is the method?—We go by the experience of 1896 and 1897.

**Vide* Report on the outbreak of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I.C.S.

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1259. What is that experience, is it that plague goes in a straight line, or zig-zag?—It has gone in absolutely the same direction in each year. It has gone south-west and north from one locality to another.

1260. In the case of cholera, there was a theory that to avoid the disease the line of the march ought to be at right angles to the wind. Is there a theory of that kind with regard to plague?—No, it is wrong. In this case the rats moved about and migrated. That is the grave fact.

1261. How do you know in which direction they are going to move?—By the experience of 1896: they moved south-west and north-east. That was the experience.

1262. (*The President.*)—Of course you cannot wait until you have a sufficient accumulation of statistics; in an emergency you must act according to the methods you think best?—Undoubtedly.

1263. You cannot have proof of the next step, you cannot wait for that?—No.

1264. With regard to a point referred to by Professor Wright, you appear in the case of a plague-stricken house to isolate the inmates who have not been infected?—Yes.

1265. In other instances you allow them to go where they like?—Yes.

1266. How do you justify that?—You cannot justify it on any theory; it is merely practical expediency. You have to deal with the people as best you can.

1267. Even assuming that you had an ample amount of segregation room, you do not see objections to allowing those who at the moment do not show evidence of plague in themselves, to go where they like?—That is so on principle.

1268. Might not a patient be removed from a house who shows no evidence of plague, but who is in the incubation stage of plague, and afterwards developes that disease in the same place?—That is possible.

1269. Might not the result of that be to spread plague very largely in the town?—The spread of plague from an individual case,—I do not think we have seen it so here although theoretically it ought to be so.

1270. It does spread by human carriage, I suppose?—Undoubtedly.

1271. Might not a single case render abortive the most perfect measures you might otherwise adopt?—I do not think it is so practically.

1272. If it could spread it?—It is only one way.

1273. But you would not put this method of allowing him to run away in the same position as segregation?—No, that is quite true. Undoubtedly, on principle, a person who is likely to be suffering from the disease ought not to be allowed to go into a place where he would be likely to communicate the disease to another person.

1274. I cannot quite understand your position. You think that in practice it is a matter of indifference?—No, not a matter of indifference. The great object is to remove or to persuade people to remove from the building where the disease occurs to the open air, or a well-ventilated building. If they can be protected a short time the disease, so to speak, will not survive. If the population could be removed from the place infected they would escape—if rats did not follow them.

1275. Then you do make a selection?—Yes. I contend that practically the danger has been over-estimated of persons from houses where cases have occurred communicating the disease. The organism neither survives long nor retains its virulence long amongst people who have been moved from the place of the disease.

1276. But you say there is such a danger and that it has led to the Municipality spending large sums of money in providing segregation camps: if there be that danger, why do you not make use of these segregation camps wherever they are available?—Undoubtedly we do make use of them, but to make use of them fully in all cases would require much larger camps and create opposition and lead to greater concealment and evasion. Were an attempt made to apply segregation without using a discretion, the people would become so opposed to it that they would evade segregation.

1277. At the present moment there is plenty of segregation accommodation?—Yes.

1278. Would you allow plague contacts removed from a house to go to a house in some other part of the town or would you always send them to a plague segregation camp?—You cannot apply a hard and fast rule. There would be opposition to any hard and fast rule by which we would be obliged to remove people to camp. I should use a discretion and allow the use of well ventilated buildings.

1279. There is not much opposition?—There would be opposition if you applied a hard and fast rule. The rules are considerably modified.

1280. You leave it optional to the people to go into a segregation camp or not?—I should leave it optional with the Plague Officer. That is what is done.

1281. Do you know upon what principle the Plague Officer acts?—I think the principle upon which he acts is that, as far as he can, he removes everybody likely to have been in contact to camp.

1282. (*Dr. Ruffer.*)—Would you add to your evidence the gross mortality from plague among segregated people, as compared with the gross mortality among the population in Bombay?—Yes.

1283. (*Prof. Wright.*)—That is what I ask for?—I will supply it.*

(Witness withdrew.)

CAPTAIN W. E. JENNINGS, I.M.S., called and examined.

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1284. (*The President.*)—You are a member of the Indian Medical Service?—Yes. I am now Supervising Medical Officer in charge of Railway Medical Inspections.

1285. I think you are prepared to give us an account of the measures taken under your supervision in respect to railway inspection; perhaps you will give us a brief history of the facts?—When it was found that plague had become established and was spreading in Bombay about October 1896, the Administrative Officers of the Great Indian Peninsula Railway and the Bombay, Baroda and Central India Railway were consulted regarding suitable measures. Before plans were properly developed by the Government, the Government of India telegraphed on October 12th, urging the prevention of the spread of plague by the adoption of railway inspection. Meanwhile, local bodies at many important places in the Presidency were instituting arrangements for their own protection, and by the 22nd October it was ascertained that those places where inspection was not in force would soon have arrangements, and about the same time Government were informed that the Southern Mahratta Railway had of their own accord instituted certain arrangements at Poona, Miraj, Belgaum, Londa, Hubli, Gadag and Hotgi. Early in November 1896, arrangements were made for the inspection in Bombay of the ten through trains leaving by the Great Indian Peninsula Line at Victoria Terminus and Byculla, and of all the through trains leaving by the Bombay, Baroda and Central India Line at Grant Road and Bandra. About the middle of December a large exodus from Bombay made it impossible for the existing staff in Bombay to cope with the work, and pending the arrival of more staff for a contemplated better scheme, the best arrangements possible were made with the existing staff. On February 4th, on the recommendation of the Government of India, it was decided to remove all passengers from down through trains at Kalyan and Palghar on the Great Indian Peninsula and Bombay, Baroda and Central India lines, respectively, and to employ at each of these stations a large staff under Commissioned Medical Officers. Observation and plague camps were rapidly erected at these places, and rules giving the necessary powers for the adequate treatment of railway passengers published under the Epidemic Diseases Act (Act III of 1897) on February 10th. These rules were soon after extended to Ahmedabad, Bhusawal, Hotgi and Londa. At Bhusawal, for the protection of Calcutta, the Central Provinces and Bengal, the staff which had existed since November 1st was augmented, and attention was also paid to Ahmedabad for the protection of Kathiawar and Rajputana, to Hotgi for the protection of the Southern Mahratta country, Hyderabad and Madras, and to Londa for the protection of Goa, Mysore and Madras. Other inspection posts were subsequently established at Dhond and Rajewadi for the protection of places in the Deccan and the Southern Mahratta country, one at Manmar, and one at Poona. In addition, barrier inspections were held at various places in the Presidency, rules to legalize which were published under the Epidemic Diseases Act (III of 1897) on February 17th. On February 23rd the Government published a list of infected areas and

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* See below record of witness re-examination on 17th March 1899.

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issued certain rules to enable local authorities at places to keep a better watch over the movements of persons coming therefrom, which necessitated their names, addresses, business, and intentions as to movements being registered. In April, the Government ordered disinfection of the baggage of passengers at Hotgi and Bhusawal. Later on, when plague had spread and was raging in several parts of the mufassil, it was found impossible to arrange for wide-spread medical inspection so thorough as to check the spread, and a system of detention camps was instituted in selected parts of the Presidency for detention for fixed periods, and disinfection of all third class passengers from infected areas. Meanwhile Bombay became practically free, and a system of inspection of through and local trains and causeways was instituted, and till the recrudescence in December 1897, detention of all arrivals from infected areas was carried out. The following statement shows the difficulties of making this absolute :—

Great Indian Peninsula line.	Bombay, Baroda and Central India line.	Possible Contingencies.	Measures adopted.
List of stations between Bombay (Victoria Terminus and Grant Road) and the terminus of the local train service on each line.		*Great Indian Peninsula.* (I).—Passengers from beyond Kalyan could book to Kalyan and re-book to Bombay in a local train.	(I).—Booking to Bombay from Kalyan and Virar was stopped except for season ticket-holders or those possessing certificates from Plague authorities allowing them to trave
Kalyan. Demauli. Diva. Mumbra. Thana. Bhandup. Ghatcooper. Kurla. (Mahim River.) Sion. Matunga. Dadar. Parel. Currey Road. Chinchpoogly. Mayagaon. Byculla Musjid. Victoria Terminus.	Virar. Nalla Sopara. Bassein Road. Bhayandar. Borivli. Malad. Goregaon. Andheri. Santacruz. Bandra. (Mahim River.) Mahim. Dadar. Elphinstone Road. Parel. Mahalakshmi. Grant Road.	*Bombay, Baroda and Central India.* (I).—Passengers from beyond Virar could book to Virar and re-book to Bombay by a local train.	
		Great Indian Peninsula. (II).—Passengers could alight at Kalyan and walk to Mumbra Diva or Demauli and book by a local train to Bombay.	(II).—The Company stopped booking at these three stations except for season ticket-holders.
		Bombay, Baroda and Central India. (II).—Passengers could alight at Virar and walk to some station south thereof and book to Bombay in local trains.	(II).—The Company promised to report if the booking from stations south of Virar increased.
		Great Indian Peninsula. (III).—Passengers could book to Thana and rebook from there to Bombay by locals.	(III).—Booking was stopped there except for season ticket-holders or those who possessed certificates from Plague authorities allowing them to travel.
		Bombay, Baroda and Central India. (III).—Passengers could book to any stations between Virar and Bombay and then re-book to Bombay in locals, as some through trains stop at all stations.	(III).—The Company consented to run all trains from beyond Virar through to Grant Road, and to stop all booking from north of Virar to any station south of Virar and north of Grant Road.
		Great Indian Peninsula. (IV).—Passengers could alight at Thana and walk to Bhandup, Ghatcooper or Kurla and book to Bombay.	(IV).—The Company would not stop booking from these stations but promised to report if the booking became heavier so that later steps could be taken.
		Bombay, Baroda and Central India. (IV).—There is no station on the Bombay, Baroda and Central India Railway corresponding to Thana.	(IV).—No steps necessary.

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Great Indian Peninsula line.	Bombay, Baroda and Central India line.	Possible Contingencies.	Measures adopted.
		Great Indian Peninsula.	
		(V).—Passengers could book from the Great Indian Peninsula to Bombay, Baroda and Central India lines and slip into Bombay at Dadar.	(V).—The Company stopped this.
		Bombay, Borada and Central India.	
		(V).—Passengers could book from the Bombay, Baroda and Central India to Great Indian Peninsula lines and slip into Bombay at Dadar.	(V).—The Company stopped this.
		Great Indian Peninsula.	
		(VI).—Passengers could book from stations north of Kalyan to stations between Kalyan and Thana or between Thana and Sion and change into local trains at Kalyan or Thana and thus slip into Bombay.	(VI).—The Company stopped booking from stations north of Kalyan to Diva, Demauli, Mumbra, Bhandup and Ghatcooper.
		Bombay, Baroda and Central India.	
		(VI).—Passengers could book from stations north of Virar to stations south and change into a local train at Virar and thus slip into Bombay.	(VI).—The Company stopped such booking.
		Great Indian Peninsula. (VII).—Passengers could alight at Thana and walk to Sion Causeway.	This was obviated by instituting a system of causeway detention.
		Bombay, Baroda and Central India. (VII).—Passengers could alight at Virar and walk to Bandra Causeway.	

There is a very large local system. Local, through, barrier, frontier and mufassil inspections with disinfection, detention camps, and other regulations to prevent infected, or probably infected, people from travelling, continued on till after the middle of 1898, modified by local indications from time to time, and as there then seemed little prospect of a speedy termination of the epidemic and as it was considered that many of the regulations in force, such as detention and others which practically close the channels of daily business and were impossible as a permanent feature of plague regulations, a resolution was issued by the Government in October 1898 replacing all existing arrangements by measures which included:—

(*a*) Stringent medical examination of each traveller.

(*b*) Careful disinfection of suspicious articles.

(*c*) Correct ascertainment and record of the location of travellers after they have been permitted to enter a town.

(*d*) Special regulations for travellers who cannot be depended upon to give a trustworthy account of their residence and movements, or are suspicious whether by reason of their appearance or symptoms, or the dirty condition of their clothes or effects.

A copy of this Resolution has been sent with my summary of evidence.* As to (*a*) and (*b*) it was decided to entrust the organization to a selected medical officer, whose duties were detailed in a special resolution, so that all inspection stations in the Presidency would be under the control of one Supervising Officer and one standard of strictness maintained throughout. The revised rules further promised that the clinical thermometer test was to be the salient feature of the system.

1286. What is this clinical thermometer test?—To take the temperature of as many passengers as showed the slightest indication of a rise of temperature, either from the condition of their pulse, or the temperature of their skin to the touch.

1287. The slightest indication of fever?—Yes.

1288. Is there a definite temperature point settled?—Yes. It was decided in the Resolution that any one whose temperature was above normal was to be detained till the next train.

1289. Did you act upon that?—Yes. We find that a fraction above normal is very much more dangerous than a high temperature, because if a passenger has a high temperature we generally know whether he has plague or not, but when his temperature is only slightly supernormal such as 99·8°, we do not know whether or not it is an indication of incipient plague in the absence of other symptoms.

1290. That is the axillary temperature?—Yes. The Government having appointed me as Superintending Medical Officer, Railway Medical Inspections, I have introduced the revised system all over the Presidency Proper (excluding Sind). During the past month, the arrangements for Poona not having been quite completed, a system of inspection which had been adopted there by the Chief Plague Authority, Poona City, was continued pending the completion of arrangements. The decision regarding the

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* Bombay Government, General Department (Plague) Resolution No $\frac{4772}{\text{[illegible]}}$, dated 17th October 1898, not reprinted with the Commission's Proceedings.

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stations where, from time to time, examinations shall be held will depend on the course of the plague, but at present the inspection posts are given in the accompanying map,* the arrow heads indicating whether passengers of Up or Down trains, or both are being examined, the yellow spots indicating infected areas, the blue lines railways, and the post marked "D," disinfection stations.

1291. Will you kindly state for the information of the Commission the results of the examinations?—The following table shows the results of medical examination of railway passengers at certain stations for varying periods:—

Stations.	Period.	Cases removed from trains for detention and observation.	Those who developed plague or were suffering.	REMARKS.
Anand .	1 year .	1811 .	93 .	15 actually suffering, 31 developed in 24 hours: 2 on 2nd day, 17 on 3rd day, 9 on 4th, 7 on 5th, 1 on 6th, 6 on 7th, 2 on 8th, 1 on 9th, 1 on 10th and 1 on 11th.
Bhusawal .	2 years .	449 .	28 .	2 actually suffering; all developed under 2 days, except 1 on 3rd day.
holapur .	11 months .	6,049 .	5 .	Developed between 2nd and 6th day.
Hotgi .	2½ months .	579 .	2 .	...
Hubli .	10 months .	30 .	15 .	12 actual cases, 1 developed on 2nd day and 2 between 3rd and 6th day.
Belgaum .	½ year .	103 .	2 .	1 suffering, developed 2nd day.

I also have the result of local examinations at Palghar and Kalyan, which are most important stations, being, so to speak, the gates of Bombay. During a period of four months at Palghar 192 passengers were taken out of the train, of which 45 developed plague. In a period of eighteen months in Kalyan 3,320 persons were removed from the trains, of which 234 were plague cases; about 50 of these were taken from trains while actually suffering from plague, and the rest developed plague in varying periods from one to seven days. The routes to Bombay, by which people could enter without coming by rail were also inspected. There are five ways of entering Bombay by road:—

(1) Mahim Bandra Causeway.

(2) Sion Causeway.

(3) Great Indian Peninsula Railway Causeway.

(4) Bombay, Baroda and Central India Railway Causeway.

(5) A tract of land often under water, but generally passable at low water between the north-east corner of the island of Bombay and Salsette.

It was necessary to close all the above routes to foot traffic except (1) and (2), where inspections of all passengers on foot, in carts, or carriages was held. Inspections commenced early in February 1897 and from then up to 30th April 1898, 73 cases were detected at the Sion and 180 at the Mahim Bandra Causeway. When detention of passengers from infected areas was in force in Bombay 190 persons were sent from the Sion and 136 from the Mahim Bandra Causeway. When the famine existed, 202 from the Sion and 225 persons from the Mahim Bandra Causeway were given a meal and sent to relief camps.

1292. The people were detained because of a rise in their temperature?—Yes.

1293. Is that the whole number?—Yes.

1294. I understand that a very large number of persons was examined but that relatively a small number was detained, and that a mere fraction of those who were detained developed plague afterwards?—Yes.

1295. The method adopted was, therefore, even more rigid than was generally required?—Yes, I think so.

1296. Certainly it erred on the safe side, it was very strong?—Yes.

1297. Are there any other points you wish to mention?—I may mention that the measures generally are most useful owing to their deterrent effects against actual plague cases or people who are probably infected travelling. The figures go to prove that very few actual plague cases are found travelling, and the probability is that all those actually suffering from plague are detected. It is only those in whose system the plague is incubating that can pass. No system of mere inspection can discover those. The tables are the results of the examinations of hundreds of thousands.

1298. Was there much attempt at evasion?—There were a great many attempts at evasion when there was detention for ten days in camps. The passengers, however, have got used to be examined now. They do not mind, perhaps, a detention for one train; but when there was ten days' detention they used to get out before they got to the inspection station, and attempt to walk past, and get in at a station beyond.

1299. Did you prevent that?—Various measures were adopted in places for preventing that; but I do not think the system anywhere could work absolutely perfectly.

1300. Those are the matters you wish to lay before us in connection with railways?—Yes.

1301. (*Prof. Wright.*)—What is the object of keeping the man back from the train; that does not settle the matter, does it?—In most places the passengers are detained for 24 hours, and you then have an opportunity of judging as to their condition. If they are merely suffering from malarious fever, the temperature goes down in that period. I think a great many people get a rise in their temperature from fright, which subsides afterwards.

1302. (*Mr. Hewett.*)—Do you find that the system of stopping only suspicious cases is as efficient as the old system when you stopped everybody?—Yes. Except that we cannot discover cases of incubating plague.

1303. Under the other system, could not persons with incubating plague escape to a considerable extent by resorting to the road?—In a great many instances they would cover their quarantine in that way. They take circuitous routes. If they were sickly they would probably die on the way.

1304. The time taken in reaching their destination is increased by reason of their going by road?—Yes.

1305. Then do you not think that the present system is as efficient as the other one?—I think the two work equally well.

1306. By stopping the suspicious railway passengers, do you practically put a stop upon the spread of plague by travellers?—Yes.

1307. Do you think that plague has been carried about by railway passengers as much as by ordinary wayfarers?—I think it has been carried about mainly by railway passengers.

1308. How do you account for the fact that in the earlier outbreak it confined itself very frequently to the limits of the Bombay Presidency?—Because people likely to leave Bombay when it was infected would not be likely to go beyond the limits of the Presidency.

1309. Is that so?—Yes.

1310. Are there not a lot of people in Bombay who have relations in Rajputana and the Central Provinces?—That I cannot say.

1311. Do you disinfect clothes at the frontier stations?—Yes.

1312. Of every third class passenger?—Not of every passenger; only those requiring it either by reason of their clothes being dirty or from the fact of their having come from infected areas. Every passenger examined brings a

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* Not printed with the Commission's Proceedings.

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bundle of clothing with him. If he looks dirty there is a very thorough system of disinfection carried out.

1313. You disinfect those whom the Inspecting Officer considers to be contaminated?—Yes.

1314. Invariably?—Yes.

1315. (*Dr. Ruffer.*)—How is this disinfection of infected clothing or suspected clothing carried out; how do you disinfect the clothing?—In four stations it is done by steam. In one station it is done by boiling the clothes, and in another (it is only a sort of auxiliary place) it is done by steeping the clothes in a perchloride of mercury solution, 1 in 1,000.

1316. What is the temperature of the steam?—Two hundred and twenty-five degrees.

1317. How do you control the temperature? Have you an electric signal thermometer?—We have not got a signal thermometer everywhere, but have pressure gauges; it is done under experts.

1318. Can you tell me where the steam disinfecting stoves are?—There is one at Anand on the Bombay, Baroda and Central India Railway, one at Sholapur, one at Manmar, and one at Hubli. At Poona there is a very thorough system. It is carried out in the same way.

1319. At Bhusawal there is one?—No. Articles to be disinfected there are boiled.

1320. Did you give the people any baths?—Not compulsorily. There are arrangements for baths at all places. The people can bathe if they like, and towels are provided for them.

1321. If any detailed examination of women is necessary, that examination is made by a woman?—Yes.

1322. (*The President.*)—I think you have had some experience with regard to inoculations?—Not with regard to inoculations; I have had some opportunities of observing some anti-toxic serum for the treatment of plague cases.

1323. Would you care to give us any information about that?—During the second epidemic I had the opportunity of observing some experiments with curative serum at Parel Hospital which was under my control. The experiments were conducted by Dr. Felix Jassenski, who used serum prepared in the Imperial Institute of experimental medicine in St. Petersburg. The serum was obtained from the blood of horses rendered immune by the repeated injection of cultures of plague bacilli in which the bacilli had been killed by heat. Cases were not specially selected for the treatment, but in order to obtain two entirely comparable groups of inoculated and control cases, the newly admitted cases were daily divided into two groups—one containing doubtful and moribund cases, and the other cases of undoubted plague (not obviously moribund). The inoculated and control cases were taken purely from the second group, every alternate one being inoculated and the remainder forming the control cases. At first, the quantity of serum injected was 20 c.c. daily in one dose, later on 10 c.c. were injected in the evening as a second dose and still later the morning dose was increased to 30 c.c. These doses, not having any effect, they were further increased to 40 c.c. in the morning and 20 c.c. at night (more than half the cases were treated with the latter doses). In seventeen of the cases the blood was examined for bacilli, and in thirteen of these the bacilli were obtained from a drop of the blood from the buboes during life, and in one case an hour and a half after death.

The following tabular statement gives results of inoculated and control cases:—

Results.	Inoculated.	Control.
Cured	2	...
Died	39	40
Convalescent	9	10
Total	50	50

Dr. Jassenski sums up the results of his experiments as follows:—"In general terms the effects of the injections of the Russian serum have been negative. In some cases the temperature fell and the patient felt better after the injections. No harmful results were noted in any case, whether on the heart, the kidneys, or any other organ. Finally, from the above results but one conclusion is possible, that the serum prepared at St. Petersburg and employed by me in the above cases is an absolutely indifferent substance, with no influence, either for good or evil, on the course of acute plague."

1324. The results are negative?—Yes.

1325. You do not know how the serum is prepared, except that it was from horses?—No.

1326. You do not know anything about its strength?—No.

1327. (*Dr. Ruffer.*)—Did you make any experiments with the blood of these patients after they had been inoculated with the serum?—Only to find the bacilli.

1328. You did not notice any difference between the inoculated and the uninoculated cases?—No.

1329. Did it seem to have any effect on the bubo?—No.

1330. On the temperature?—The temperature fell in some cases after the injections, but went up again.

1331. How long was it before it fell?—It fell soon after the injection and remained down from two to four hours.

1332. You have not tried the effects of a simple salt solution instead of serum?—No.

1333. (*Prof. Wright.*)—Do you know whether the strength of the serum was tested on animals?—I do not know whether it was or not.

1334. (*Mr. Cumine.*)—What is done with the railway carriage from which a plague case is taken?—The carriage is either disinfected at the destination before reaching which no one is allowed to use it or if possible it is at once taken off and disinfected.

1335. Supposing a case of plague was taken out of a carriage at Manmar, what would happen to the carriage?—They would probably keep the carriage there, or at Bhusawal; if it was a mail train, they would not delay it, but if it was a mixed train the carriage would be taken off.

1336. What would be done with the other people in the carriage?—They would be put into another compartment.

1337. They would not be detained?—No.

1338. Is not there an order of the Government of India that the carriage must be disinfected at the frontier station?—Not that I am aware of.

1339. I suppose that at many of the small stations in the Presidency, persons alighting are examined by local bodies, are they not?—Yes.

1340. At one time there were detention camps for almost all passengers from infected areas. In the table you gave us shewing the results of medical examinations of certain stations, do you include persons detained merely because they were passengers and independently of any sign of plague?—No. They were not included. The only case in which they may have been included is at Sholapur. They return six thousand so that I think they must have included these.

1341. When there was detention of people from infected parts independently of their temperature, did not the railway passenger traffic come down to almost nothing?—It was reduced about 50 per cent.

(Witness withdrew.)

MR. J. H. DUBOULAY, I.C.S., called and examined.

Mr. J. H. Duboulay.

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1342. (*The President.*)—I believe you are Deputy Commissioner for Plague Operations in this city?—Yes.

1343. Of course your knowledge is very intimate as to the measures which have been adopted?—Yes.

1344. Would you describe what is being done at the present time with regard to the restriction of the plague?—I cannot give you any statistics now. The city is divided into nine Divisions; each division is under an officer—six are Staff Corps Officers, one is a gunner, one is a Musalman gentleman from Sind, and one is a Parsee medical officer who has been working here for some time. Each District Officer has a staff of Doctors and Sub-Inspectors, muccadams and coolies. A muccadam is a head-man of coolies. The District Officer is also assisted by committees of volunteer native gentlemen. There are about 900 gentlemen serving on these committees now.

1345. Distributed among the wards?—Throughout the city. Altogether the total number of these volunteer gentlemen distributed is 900, and about 300 of them are doing very valuable work. The first difficulty we have is that we find people concealing plague, because they do not like our measures. The volunteer gentlemen visit the people. They distribute the city among themselves, and each District Officer is in charge of the volunteer committee in his own ward. They distribute the section among themselves, and visit it day after day: according as the incidence is greater or less, they visit it more or less frequently. They get information given to them, and they give that information to the District Plague Officer who also visits the infected localities,—where there has been plague, and where he suspects there is plague. He also gets information from his own staff and from the Health Department staff. He also gets information from the cemeteries, and from the hospitals. A certain number of patients go to the hospitals voluntarily, and that information comes to him. Those are the ways in which we find out where plague exists. As soon as a case of plague occurs, the Medical Officer goes to the house and looks at the patient. If he is satisfied that it is plague, he writes a certificate and sends the patient off in an ambulance to the nearest hospital. In case the man is a member of one of the castes which have their own hospitals, he sends him to whatever hospital he may select. He then makes a list of the people who are called "contacts," the friends and relations of patients who may be living in the same room. As soon as there is information of a case, the Contact Inspector (a man who is appointed to the special duty of segregating contacts) goes to the house. The Medical Officer hands the list to him, and it is his business to send them off to one of the camps. The contacts are kept there ten days. The house is then disinfected with perchloride of mercury principally: the privies and washing places are also disinfected with carbolic acid. That is the procedure with regard to a single case. If a house has a series of cases occurring, the house is evacuated. The house is evacuated either by exerting the influence of the members of the volunteer committees, who are to a large extent influential native gentlemen who talk to the people and show them the necessity of leaving the place, or else by serving a notice which is executed through the Health Department with the assistance of the police. But where you serve a notice in that way, you have not much control over the places to which the people go: you merely get them out of the dangerous house. On the other hand, if you can get hold of a member of the volunteer committees to talk to the people, and persuade them (in some cases the District Officers themselves have that influence), you can get them into one of the health camps. They are kept there for ten days and very often they remain there. In some cases we charge rent to the people who refuse to leave these camps. Sometimes they prefer to stay in the camp. The volunteer committees assist in various other ways. In the course of their inspection they notice sanitary defects in houses, in the way of dampness, bad water arrangements, bad sanitary arrangements, and bad ventilation. These they report to the District Officer who is constantly reporting such cases to me. Such cases are forwarded on to the Health Department or the Executive Engineer. The Executive Engineer has a large staff for surveying houses. When he gets a requisition of this kind, he surveys the house. If he considers it incapable of improvement he orders its evacuation, and he gives notice. The house is then evacuated and demolished. If he considers the house capable of improvement, it is not always evacuated. Some of these committees always work independently. One of the best committees we have is the Nagpada Committee. The average mortality before the epidemic broke out should have been about 518. As a matter of fact there occurred 545 deaths. The committee have removed 93 cases of plague to the hospital. There were also 43 cases which they observed, which were in a collapsed condition, and were allowed to remain in the houses until death. But in C Ward they are very well organized and give great assistance in all the ways I have mentioned. I think that is a general outline of things.

1346. Your experience shows you that these committees discover the cases?—They discover the cases. But as I have told you, this is the best committee I have. It is almost as good a committee as you could have. It works almost independently. It is very much better than a great many of them.

1347. Are there districts where the work is not satisfactory?—In some of the districts the committees are not so good. The system is different in some of the districts.

1348. The great result is that you get early information of the existence of plague cases?—That is what we aim at.

1349. And you succeed?—We do succeed there; and in a great many districts. In certain districts, however,—the Musalman districts,—we are not very successful. Judging by the high mortality that occurs and the very small number of plague cases we hear of, we gather that we are not very successful. The Musalman District Officer has lately come from Sind and his efforts are showing some signs of success. At the present moment there is not much plague in the district he is in charge of; but he is getting members who profess to be volunteers to do some work.

1350. I understand you to say that the people are now much more reasonable in going into segregation camp than formerly?—They go much more willingly.

1351. They like them and it is difficult to remove them from the camps?—That is not the case so far as going to the camp is concerned: it is after they have got there, and find they are put to more trouble.

1352. They like the camps?—A number of them,—I do not say all. A number of them prefer to stay there and pay rent.

1353. Who has the supervision of the special Plague Hospitals?—Colonel Wilkins.

1354. (*Mr. Cumine.*)—Are the camps that the people like to remain in really segregation camps?—We call them segregation camps; but as a matter of fact the people are allowed to go about their ordinary avocations. The contacts are the only people whom we treat at all strictly, and we have very much modified regulations with regard to them. We merely tell them that they have to come back to camp at night. We tell them that they are not to sleep out. We have not found that that has resulted in many of them running away.

1355. (*The President.*)—Generally speaking, there is very little plague in these camps relatively to the amount in the outside population?—I can give you the figures for January, February and March at the Wari Bandar Camp, which is one of the best organised camps. There were 5,363 admissions and 131 developed plague. Of these, 39 were on the day of admission; 30 on the first day after admission; 19 on the second; 13 on the third; 11 on the fourth; nine on the fifth; six on the sixth; one on the seventh, one on the ninth and two on the twelfth day after admission. The last four cases were cases of re-contacts,—that is to say, persons who had been living in this contact camp with their friends, and some or other of their family had got plague there, which is one of those others included in the first numbers. They were accordingly not allowed to leave camp until the expiry of the time.

1356. (*Mr. Cumine.*)—Wari Bandar was a real contact camp as opposed to a so called segregation or a health camp, was it not?—Yes. The rule was that only males were allowed out. They had to give a guarantee. They were allowed out on passes. They had to give a guarantee to some respectable person who could be trusted, that they would come back.

1357. (*Prof. Wright.*)—The figures given are for three months?—January, February and March.

1358. How many cases of plague were there during these three months in Bombay?—In January there were 2,907, in February 7,450, and in March 4,780. Those are the reported cases.

1359. (*Dr. Ruffer.*)—What is the total population of Bombay?—By the last Census it is 821,000. I should say it is between nine and ten lakhs now.

1360. (*Prof. Wright.*)—Do you know what is the incidence of plague, calculated upon the population of Bombay as a whole: it works at one in 40 in eighteen of the towns?—These are the reported cases. It does not include concealed cases. The figures for total deaths at that time were 6,801 in January as against 2,907 plague cases.

1361. Do you estimate the mortality of plague from these returns?—No, these are the mortality cases.

1362. But what percentage do they present to actual cases of death from plague?—That is a matter which one must calculate out. I presume you take the average monthly mortality at about 2,100.

1363. Would you deduct these 2,100 from the total deaths to arrive at the plague deaths?—You get something like that from plague deaths. You add on cases which recover. I have not told you about one or two other directions in which action is being taken. There is inoculation. The Municipal Commissioner has had a conversation with the leaders of influence among the Hindus, and he has endeavoured to get them to co-operate in matters

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of inoculation; and I have also been allowing small payments to poor people who are prevented from going about their ordinary avocations owing to fever; and encouragement is given to our own medical officers and certain practitioners. In all about 25,000 people have been inoculated.

1364. You also have inoculation stations?—Yes.

1365. Do you know how many there are?—There are a considerable number of medical men doing inoculation work at the present moment. There are only one or two fixed inoculation stations.

1366. How many did you say was the total number that had been inoculated?—Twenty-five thousand three hundred and fifty-eight people have been inoculated this year, up to the week ending the 26th November. Of these 17,437 were inoculated up to June the 4th: the rest have been inoculated since. Inoculated people also get certificates which are to a certain extent effective in passing them through the examination on railways. People who have been inoculated are not treated as contacts: they are not removed to a contact camp.

1367. (*Mr. Hewett.*)—Inoculated within a certain time?—Not less than 10 days before and not more than six months. As regards rats, a reward of half an anna is paid to people who bring rats in to the Health Officer. Altogether 50,400 rats have been paid for since August. Twelve thousand and eight hundred were destroyed from January to July.

1368. Those are the measures you adopt now?—Yes; and tile-turning is another.

(Witness withdrew.)

(Adjourned till Monday, December 5th.)

At The Secretariat, Bombay.

SIXTH DAY.

Monday, December 5th, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.
MR. C. J. HALLIFAX (*Secretary*).

CAPT. L. F. CHILDE, I.M.S., called and examined.

Capt. L. F. Childe.

5th Dec. 1898.

1369. (*The President.*)—You are now acting as the first physician in one of the large hospitals of Bombay?—Yes.

1370. You have accordingly had a good deal of experience in connection with plague?—Mostly from a pathological aspect rather than from a clinical, but I have seen a great many clinical cases also.

1371. Have you made any investigations in connection with plague?—I did, as a member of the Plague Research Committee, appointed by the Government of Bombay.

1372. You were a member of the Plague Research Committee, also?—Yes.

1373. Have you seen the plague from its commencement in Bombay or almost from the commencement?—From September 24th 1896.

1374. Have you formed any idea as to the origin of the plague here?—No; I did not come to certain conclusions at all.

1375. Or as to the diffusion of the plague through the city?—One has observed that the death of rats from the plague has usually preceded an outbreak in any portion of the town.

1376. Has that come under your observation, or do you speak as a matter of hearsay?—I have seen it at Malabar Hill especially.

1377. Will you give us some details of the case you refer to?—At first Malabar Hill was free from plague until about January 1897; I am not exact as to the date, but I think this is about right. First of all rats died in one particular house, and shortly afterwards the servants of that house became attacked, and then the rats in the adjoining houses died. That seemed to be the centre of the origin of the plague at Malabar Hill at that time.

1378. Rats in the adjoining houses died?—Yes.

1379. In the adjoining houses plague also occurred?—Yes.

1380. I suppose these houses were inhabited by people in good social position?—Yes. The owners of the houses were in good social position. It was their servants who were attacked.

1381. Only the native servants?—Yes.

1382. Was any European in that quarter attacked?—Not at that time.

1383. And not only no European, but no native of good social position?—Not that I remember.

1384. But you do remember that the servants were attacked?—Yes.

1385. Without the others being attacked in the houses which you refer to?—Yes.

1386. What clinical forms of the plague have you observed?—Mainly three forms; the bubonic form in which there is one large external bubo; and secondly, a form in which there are a number of enlarged glands to be felt all over the body in the various regions, but not one special bubo, that is, not one place where the glands are especially enlarged; and thirdly, the pneumonic form in which no glands are found to be enlarged. Then I have also seen the combination of the pneumonic form with what we have called plague septicæmia, that is where glands generally all over the body are enlarged.

1387. Interior, exterior, or both?—Mainly the external ones.

1388. In the pneumonic form were any of the mediastinal glands involved?—I found those in the bifurcation of the bronchi, not in every case but sometimes they were distinctly enlarged.

1389. What about the tonsils or the throat?—In many cases we found the tonsils distinctly engorged.

1390. Were these cases only of the pneumonic variety or of the other two varieties?—In all varieties, I did not notice that it was particularly in the pneumonic form.

1391. From the results of your observations, what do you think are the channels of introduction of the virus itself?—I think in some instances through a small lesion on the skin. I made some investigations on that point, and there is also the evidence from persons who have made *post mortem* examinations, showing a distinct infection through the skin.

1392. You have made some interesting observations, I think, with regard to the bacilli being found in some parts of the skin and lesions of the skin?—Yes, I have.

1393. Tell us about this please?—I began on the assumption that the plague bacillus might be able to enter through the skin; and then I noticed that all the plague patients had many abrasions on the skin. Most of the patients being of the lower class, they had slight injuries on the hands and feet, and very often a scratch-mark from parasitic diseases such as ring-worm, scabies, and so on. Then I examined a large number of slight abrasions in the various patients, to see if I could isolate the plague bacillus from any one special lesion; and in four instances, I believe, I succeeded in isolating the plague bacillus from a small lesion on the surface.

1394. You believe you did?—Yes; it corresponded to all the tests.

1395. You found the bacillus?—Yes, and the growth was exactly like that of the plague bacillus.

1396. And the cultivations were exactly the same?—Yes I injected them in rats, who died of plague.

1397. Do you consider the evidence complete?—Yes, I believe it was complete.

1398. That evidence consisted of what?—The plague bacillus being in these lesions. The lesions I found were like a small papule which had been scratched. There was a slightly inflamed base, a little serum on the top and then a scratch-mark.

1399. A small vesicle?—Yes, and I found a hair growing through it like an inflamed hair follicle. None of the patients knew about this lesion; it did not cause them any pain or discomfort and they were not aware of its presence. Then I removed a little of the serum from the papule and inoculated that upon agar tubes.

1400. I suppose you cleaned the surface?—Yes; I did that carefully with all ordinary precautions. In many instances I completely failed; I found only impurities and not the plague bacillus at all, but in these four instances I got the growth, and by means of cultures I ultimately got the pure growth, which I believe was the plague bacillus itself.

1401. What are your reasons?—It had exactly the appearance of plague bacillus growing on agar. In each case I inoculated some of that into a rat which died after about 60 hours, and the *post mortem* on the rat showed that he died of plague.

1402. What about the microscopic appearance of the bacillus in this case?—I waited two or three days and got involution forms which were exactly like those of plague.

1403. Can you remember on what days in the illness you succeeded in finding bacilli?—I have that all here. The first one was a Hindu who said he had been ill for three days; he said that three days before he had been seized with fever and shortly afterwards he found pain and swelling in the left axilla. The second one also said he had been ill for three days. The third had been ill for two days. The fourth said he had been ill from two to four days.

1404. Now let us take the first case; where was the lesion where you got the bacillus?—When he came to the hospital he had a bubo in the left axilla; I examined the whole of his left arm and I found only one papule in the fore-arm; I examined his fingers and everything, but could not find anything else.

1405. It was in this papule you found the bacillus?—Yes.

1406. On the left arm and the left axillary gland?—The bubo was in the left axilla.

1407. And now the second case?—It was on the outer part of the right leg, and he had a bubo in the right femoral region.

1408. And the third?—The third was a man who had a bubo in the back part of the left axilla, deep down towards the back and he had a small papule close to the left scapula.

1409. And the fourth?—The fourth was a boy who had a papule on about the middle line of the penis, on the glans penis, and he had a large gland in the inguinal region on both sides.

1410. Is that not in accordance with your general observations that the glands are apparently affected in the proximity of the position where the bacillus entered the body?—I believe the evidence of persons who have made *post mortems* shows that.

1411. You refer in your printed statement* to plague being communicated to persons who have made *post mortem* examinations?—The first record I saw was in the report of plague at Hong-Kong in 1896. It says that two Japanese physicians were infected while making a *post mortem* examination, and were attacked a few days later by plague. They had axillary buboes and lymphangitis of the arm which spread upwards from the small inflamed *post mortem* wounds of the fingers. Then we had one instance at the Jamsetjee Hospital. A student was helping in the *post mortem* of a case of plague and he pricked himself in the left thumb, a very slight prick which he did not notice at the time. After about half an hour he washed out the prick. About three days afterwards he got a bubo in the corresponding left axilla and died of plague.

1412. These are all?—There was one reported at Madras in the first instance of plague there; but I only saw it in the newspapers.

1413. (*Dr. Ruffer.*)—Was not there a case in the German Commission?—Oh yes, I forgot him, Stricker; he was believed to have got plague from a *post mortem* wound.

1414. (*The President.*)—Going back to the fourth case where you found the bacillus in the external lesion, did you look for a bacillus in the blood or anywhere else?—In each case I took a culture from the finger blood at the same time.

1415. Only at the same time?—Only at the same time. I did not find it in the blood at that time in any instance.

1416. With regard to the blood what did you do with it?—I inoculated that on agar tubes.

1417. Without any result?—Yes.

1418. In the ordinary plague, I think you told us a moment ago, you have conducted a great many *post mortem* examinations?—Yes. I have made about 50 altogether.

1419. Could you give us a summary of what you found in these examinations?—Taking the bubonic form first, which is the commonest, there was very often some petechiæ over the seat of the bubo and sometimes on the corresponding limb, and that limb was frequently swollen with some œdema; I always looked for scratch-marks on the body or skin-lesions, and very often one saw various kinds of scratches, slight lesions. On opening the buboes one finds an enormous amount of extravasated blood and serum; and in the midst of this extravasated blood one sees the gland. So that the whole mass really consists of an enlarged gland enclosed in a great deal of blood. The glands were of the size of a walnut or an almond or a little smaller, and on section they looked like ripe mulberries; sometimes quite red, deeply engorged, and rather soft; sometimes they were rather firmer and they varied in the amount of engorgement. They were frequently lying quite against the large veins like the femoral or axillary vein, and one would find hæmorrhage from the enlarged gland right up against the vein, and in the wall of the vein too. I generally found no alteration in the lymphatics close to the bubo; sometimes they looked a little swollen, but very often one found nothing abnormal about them. Then the remaining lymphatic glands of the body in a bubonic case would be a little engorged, slightly enlarged, but not at all like the appearance of the glands in the bubo itself.

1420. The glands at a distance?—Yes, I mean at a distance, of the other limbs; there was not much change to be seen in them. In the other organs the main point was intense engorgement and extravasation of mucous surfaces, especially in the stomach; petechiæ were always found and little hæmorrhages on the surface; and then again in the rectum and large intestine, but not so much in the smaller intestine. We found these hæmorrhages, mostly in the large intestine, and in the stomach.

1421. In the duodenum?—I do not remember finding them there. I never found any distinct ulceration or anything very marked. Then in the pelvis of the kidney there were frequently hæmorrhages and down the ureter and in the bladder also. The lungs were always intensely engorged and very often small hæmorrhages were found in the lungs and underneath the pleura. Then the muscle of the heart was often soft and flabby, and one noticed in some cases, the heart was dilated and the muscle was softer than it ought to be. In the brain and nervous system there was a good deal of engorgement of the vessels, and the puncta cruenta looked distinct, but I never found any softening or any actual hæmorrhage in the brain, any special meningitis or anything like that. One often found that the tonsils were engorged; the whole of the mucous membrane of the mouth and pharynx was engorged and the tonsils were also engorged. In the septicæmic form there is not one bubo at all. After death one would find the femoral glands on both sides and the axilla on both sides, and

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the cervical glands all enlarged, and some of them had almost a pink creamy colour, and on cutting into them they had a slightly yellowish colour with a pink tinge all through it. Some of them would be rather firm and others somewhat softer, but there was especially this pinkish cream colour which one came to think was characteristic of this form of plague, because one found it in one of the set of glands, I think invariably. Some of the other glands would be only engorged, a little enlarged; and the rest of the appearances throughout the body were practically the same as in the bubonic form in all the other organs. In the pneumonic form the main changes found were in the lungs themselves. There would be intense engorgement of the lungs generally, and besides that a large number of isolated solid patches, rounded, having the ordinary appearance of broncho-pneumonia, only there would be no inflammation of the bronchi at all, it was not like an ordinary broncho-pneumonia with engorged mucuous membrane of the bronchi; one did not find much of that, but just these patches of pneumonia scattered through the lungs. Some of them were as large as hen's eggs, some might be only as large as peas. There was always a ring of engorgement round them, and always a more solid centre of the mass. In this form of plague the lymphatic glands of the body sometimes looked normal, and were sometimes a little engorged, but not enlarged at all, with the exception that in the bifurcation of the bronchi we found them sometimes distinctly enlarged. There was general engorgement of the other organs, and petechiæ would be found in these cases also, and hæmorrhages of the mucous surfaces.

1422. Is this pneumonia in both the lungs?—In both the lungs.

1423. And involving a very large part of the lungs?—I once found a patch which occupied half the lower lobe of the right lung; that was the largest I ever saw.

1424. Was the pneumonia generally a lobar pneumonia?—No, scattered about in any part.

1425. What was the condition of the blood, I mean from the ordinary observation of the *post mortem*?—I think it was rather fluid, but I am not certain about that; I think it was not coagulated as much as is usual.

1426. Have you ever made any microscopic examination of the heart itself?—Yes; I found in these cases of flabby heart that some of the muscular fibres had lost their striation and they had a broken-up appearance like one sees in the degeneration in typhoid fever; it looked very much like that.

1427. I think you told us that in those four cases you could find no bacillus in the blood?—No.

1428. Have you been more successful in any other cases?—I have not found it in early cases at all. By 'find' I mean 'prove by means of cultures that it is present.'

1429. Not in the early stages?—No.

1430. But you have found it?—I found it always after death.

1431. You have never found it during life?—Once before death, 24 hours before death.

1432. Only once?—Only once.

1433. Out of a great many examinations?—Yes. But the most I examined were the early ones. I did not examine the blood shortly before death in many cases; but one hour after death one could cultivate the bacillus from the blood.

1434. You have never failed after death?—No, not when I tried; I did not try in every single case.

1435. I think you have made some observations with regard to the escape as it were of the bacillus from the body. You have been speaking of its entrance into the body?—Yes.

1436. Will you give us some account of that?—First of all in pneumonic cases one can cultivate the plague bacillus from the sputum during life, and always after death one can grow the plague bacillus from the contents of the bronchi. Then it can be isolated from the urine after death; the bladder I generally found full after death, and I have been able to grow plague bacillus from the urine. Dr. Bitter obtained it once from the mucus of the large intestine. I have not done that; I have not examined the vomit, but I have got it out of the sputum during life and out of the urine after death.

1437. The fæces?—No, I could not get it out of the fæces at all.

1438. Have you tried?—Yes, but I failed altogether.

1439. Perhaps you will give us some account of your views as to the infectiousness of the plague?—That seems to depend mostly upon the surroundings of the patient. I think in a small room, crowded with many people, and in insanitary conditions the infectious power is high; in a well-ventilated house or a hospital the infectiousness is very slight indeed; that refers specially to the bubonic form, because I think in many circumstances the pneumonic form is highly infectious. Dr. Manser, who got the pneumonic form of the plague, was living in a good house, well ventilated and sanitary, and one of the nurses who attended him contracted the same form of plague from him. Then again in the Jamsetjee Hospital at the beginning of the epidemic a large number of cases of plague were let in by mistake, at first, not being properly diagnosed; but no cases of plague spread from them at all, neither among the patients nor the attendants.

1440. To what do you attribute that freedom?—To good sanitary conditions, plenty of air and sunlight.

1441. And no over-crowding?—Yes.

1442. You have no doubt whatever that the insanitary conditions are the most favourable conditions for the spread of the plague or the infection of the patient?—I do believe that.

1443. You have no doubt about it?—No.

1444. Have you any observation to support your view?—Firstly, there is the fact that the incidence of the plague in Bombay has been almost entirely among the lower classes, who are certainly crowded up together a good deal. Although cases have occurred among the better classes, there has been no epidemic among the Europeans or among the higher classes of natives, I think.

1445. That is the reason you adopt that view?—That is the main reason.

1446. Do you think that there is any spread of infection by the rats secondary to the favourable conditions produced by insanitary surroundings?—Oh yes.

1447. In other words I mean that the rats' capability of conveying the disease might operate in a sanitary dwelling without producing the plague, whereas you think they would almost inevitably produce it under insanitary conditions?—Yes, I do believe that; I know of one instance on Malabar Hill where rats died of plague in a bungalow; not in the servants' quarters, but in the living parts of the house; but none of the inmates got plague at all there.

1448. But on the other hand if as you have said the lesions of the surface have a most important bearing upon the entrance of the bacillus, will these poorer people not be more liable to be thus infected than the well-to-do people?—Yes.

1449. But notwithstanding that, you adhere to the view that insanitary conditions are the predominating features in the extension of the plague?—I do think that.

1450. I think you have some observations to make with regard to the plague occurring in pregnant women?—Yes. I saw one case of that sort.

1451. What are the most interesting facts in connection with that?—The woman was attacked with plague shortly before term, a few days before she was expected to be delivered, I think about five days, and the fœtus was born alive in an ordinary confinement and remained perfectly well; but the mother died shortly after confinement, and her body showed all the ordinary appearances of the plague in every way. I know that a month afterwards the baby was alive and showed no signs of the plague at all.

1452. Did you draw any inference from that, with regard to the natural history of the bacillus in the body for example?—No; I only saw that one case.

1453. Did it teach you anything at all?—It showed that the fœtus had become immune in some way, I think.

1454. That could scarcely be within two or three days; however, you have not thought on that point?—I did not go into that.

1455. In the next place your attention has been turned, I think, to probable infection by the earth floor of the dwellings?—I have examined specimens of the earth.

1456. What have you to communicate as to that?—I have not been able to isolate the plague bacillus from specimens of the earth.

1457. Will you give us a description of what you did for the purpose?—Yes. I collected the earth and the cow-dung from the floors of the dwellings of the patients who were then suffering from the plague, and who were vomiting on the floor itself close to the bed.

1458. Did you take it yourself?—Yes. Then I first incubated a little of the earth in sterile water for 24 hours and then I inoculated some of this from the sterile water; after 24 hours I inoculated it first of all into agar tubes, also on to Petrie's dishes, and also some into rats. Neither from the agar tubes nor Petrie's dishes could I get any colonies which looked at all like the plague. I made various sub-cultures, but never succeeded in isolating it. I also inoculated these cultures into rats, but none of the rats died of the plague; some of the rats died, but they did not show the *post mortem* appearance of the plague at all. I also inoculated these cultures into bouillon flasks, but the appearance of the growth was not at all like what Haffkine has described. I was not able to find it at all.

1459. How did you select the earth? Did you follow any plan in the floors of the room?—I had some sterile bottles and I went to where I thought the patients had been vomiting or might have been passing urine or spitting close to the bed, and I took some of the earth from there and put it into the bottles.

1460. Generally from one part of the same room or from several parts?—No, several parts of the room, I might have taken three or four specimens from one room. Some of the rooms were cow-dung floored and some stamped-down earth.

1461. Was it the surface matter or did you go below the surface to some extent?—No, I only took the surface.

1462. Did you take any scrapings from the wall?—No, I did not try them.

1463. Only from the floors?—Yes.

1464. You have had some experience, I think, with some of the serums which you used in connection with the plague?—Only Yersin's serum.

1465. Did you use it as a therapeutic or prophylactic?—I saw two cases which Yersin treated himself therapeutically, one was a European young lady and another a Parsee lady.

1466. In good houses?—Yes. The European lady was living on the Malabar Hill.

1467. Was the house of the Parsee a good one also?—Yes, it was in the Fort, but still it was a good house in this part of the town.

1468. Will you tell us about the first case, the case of the European?—She was attacked about mid-day on March 21st 1897, with fever and rigors. Yersin saw her that day in the afternoon, but she had no bubo and no diagnostic signs of the plague then, so he said he would not do anything at that time. I saw her the following morning, the 22nd of March, and again at mid-day and then in the afternoon; one could feel a small painful swelling in the left axilla. Yersin came again and inoculated her with 30 c. c. of the serum just about 30 hours after her first symptoms. He saw her the next day, but her temperature had then fallen, and he did not inoculate her again as he thought it was unnecessary. She died the next morning.

1469. She had how much altogether of the serum?—She had 30 c. c.

1470. Altogether?—Yes, at one time.

1471. But the total amount?—He did not inoculate any more.

1472. Then as to the other case?—In the other case the girl suddenly got fever on the 23rd of March about the middle of the day. She was taken to Yersin and he inoculated her the same night with 50 c. c. The following morning her temperature had fallen and she got no further symptoms of the fever at all.

1473. What symptoms did she show before the inoculation?—She had a sudden attack of fever and she said she had some pain in the left groin, but there was not much to be felt.

1474. Was there nothing to be felt?—I did not see her that day at all; I saw her the following morning after she was inoculated and when her fever had dropped; and I could not feel anything at all then.

1475. Therefore the only evidence as far as you know of the plague was the pyrexia?—Her sister told me there was a painful place in the left groin, but when I saw her the next morning, I could not find any pain.

1476. Had she been to your knowledge exposed to infection?—There was a good deal of plague near her at that time.

1477. But no special infection?—No, she was a teacher in a school.

1478. Did she get well?—Yes.

1479. Were those symptoms of the plague very definite?—No, I was not perfectly certain whether she had plague; that is the point I could not satisfy myself of; about a week afterwards she got an attack like acute rheumatism. She got severe pain and swelling of the joints and high fever, and altogether she was rather bad.

1480. Do you associate that with the former occurrence in any way?—I do not know, I only state it.

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1481. Have you any information with regard to Haffkine's inoculations?—I have myself inoculated about 400 people altogether; I have not seen any bad results following it in any persons whom I have inoculated myself. I have not seen any collapse or bad result of any kind.

1482. How did you determine the dose which you employed in these inoculations?—By the bottles sent out, the dose is written upon the bottles, but I never injected the maximum dose at once, I always did it in two operations and sometimes three. I noted the result the first time, and if there was a severe reaction I only gave a smaller dose next time; if the reaction was slight I would give the larger dose next time.

1483. You used less than the marked dose?—Yes.

1484. Did I understand you to say that that produced a distinct reaction?—Yes, it produced a reaction.

1485. You did not in any way estimate the dose which you should administer by the amount of the reaction?—Only roughly.

1486. Why did you give less than the dose mentioned on the bottle?—I had not seen, but I had heard of persons who had collapsed under the inoculation, so I thought it was wise to give a smaller dose at first.

1487. You have no direct observation?—No.

1488. You have only heard something?—Yes.

1489. (*Dr. Ruffer.*)—You were a pathologist at the hospital, I understand, when the first case of the plague occurred at Bombay. That is in August 1896?—Yes.

1490. Do you remember at the time, before the first case of the plague was declared, any case which might have aroused your suspicion at the hospital; did you see anything to rouse your suspicion before the plague was declared?—No. I have looked through the *post mortem* records of that time, and I have not been able to find anything which might have been the plague.

1491. You feel certain that if a case of plague had been present in the *post mortem* room you would have noticed it?—Except the pneumonic form. I should probably have mistaken such a case for ordinary broncho-pneumonia. But I do not think I had one bubonic case in the *post mortem*.

1492. You have been a pathologist here for a long time and have had a great experience of the diseases in India. Have you ever seen a case resembling this epidemic of plague, either here or elsewhere, before the beginning of this epidemic?—No, I do not think so.

1493. You have no reason to believe there are endemic foci of the plague in India, this is not within your personal experience?—No.

1494. I suppose you have a complete statement of the cases in which you found bacilli in the lesion of the skin?—Yes.

1495. I think I saw you refer to notes; could you furnish the Commission with a printed report*?—Certainly.

1496. And also the notes of the two cases treated by Yersin's serum?—Yes, the notes are as follows:—

Notes of two patients treated by Yersin's Serum.

(1) Miss C., an Italian, stout and healthy, aged 26, was suddenly seized with a rigor at noon on March 21st 1897. At 3 p.m. her temperature was 103° and Yersin was called to see her, but he did nothing. In the evening her temperature was 105° and there was headache with vomiting and general malaise, so Yersin was informed of her condition but he did not come again. During the night 20 grains of antipyrin were given in three doses and the temperature had fallen by morning to 98.°

March 22nd—7 A.M.—I then saw her for the first time and found her looking rather ill; she said she had pain under the left arm but no gland could be felt. At noon she had a rigor and her temperature rose to 101°, and at 1 P.M. with another rigor her temperature went up to 104·6, and now I could feel a small gland deep in the left axilla, moveable and painful when pressed; headache, vomiting and malaise as before, but no delirium. At 8-15 P.M. Yersin came and injected 30 c.c. of his fluid in the flanks. At 10-30 P.M. the temperature was 102° and then she slept.

March 23rd.—At 2-30 A.M. the temperature was 98° and so remained til 8 A.M. But then it gradually rose till it was 100·2 at 1-30 P.M. Yersin then saw her, said he was satisfied with her condition and did not inoculate again. During the afternoon the temperature gradually rose and reached 102·6 at 8 P.M.; also she was more restless and looked worse, and had pain both in the left axilla and shooting down the left arm. Yersin was informed of her condition but did not order any further inoculation.

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March 24th.—She passed a very bad night and was feeling ill, restless and prostrate, with headache, nausea, failing pulse and pain as above. At 5 A.M. she had a hæmorrhage from the uterus of 5 ounces, (she was menstruating) and at 7 A.M. she insisted on getting out of bed and immediately died from heart failure. I saw her just after death and found a number of dark hæmorrhagic spots on the left arm.

(2) Miss M. A., Parsee school teacher, aged 19, suddenly felt feverish on March 23rd, 1897, at midday. During the afternoon the temperature gradually rose to 102° and she complained of pain in the left inguinal region. She was taken to Yersin, who injected 50 c.c. of his fluid at 6 P.M.

March 24th.—During the night the temperature gradually fell and was normal at 6 A.M. to-day. I saw her at 11 A.M. for the first time, when her temperature was normal and she was quiet, feeling only depressed and rather weak. I could not find any pain or enlarged gland in the left inguinal region, but I was told that pain and a slight swelling like a gland had been felt here on the previous day. Patient remained well with a normal temperature until April 1st; on this day her temperature rose to 100° and patches of erythema which were hot and irritable began to appear all over the body; she was restless, vomiting and very uncomfortable.

April 4th.—This condition persisted until to-day when it subsided and was succeeded by acute pain and effusion in the joints. Her state was now like that of a person suffering from rheumatic fever and one after another the joints of all the limbs were affected.

April 9th.—By this date the inflammation of the joints subsided, and she gradually recovered her health completely.

1497. In the case of the Parsee lady, who was inoculated with Yersin's serum, you say she had an attack resembling rheumatism after a week, was that similar to the case of joint-pain which you get after diphtheria serum?—That is what I suspect; that is what it reminded me of.

1498. Similar kind of thing?—Yes.

1499. You would be disposed to attribute this to the serum itself?—I only saw this one; I heard something of the same kind at the Parel Hospital, but I did not see these cases, persons who after Yersin's serum got pain in the joints.

1500. As to the presence of the plague bacilli in the urine after death, did you ever notice or have you any experience of finding the plague bacilli in the urine during life?—No.

1501. You have never looked?—No, I have not.

1502. Have you looked in the urine or the fæces of the rats, or the rats which were inoculated with the plague?—I remember examining the fæces and I did not find it there. I think I must have examined the urine and failed, because I do not remember finding it in the urine.

1503. (*Mr. Cumine.*)—Where you took scrapings of earth from floors, was the patient lying on bed or on the ground?—On a charpoy, a native bed.

1504. Was that the first case which had occurred in that room or was there any reason to believe that the floor had been rendered infective by some previous plague patient having been lying on it?—I am afraid I cannot answer that.

1505. You say you have found a sort of pimple on a man's fore-arm and that he had a bubo on the corresponding arm-pit; I suppose he had scratches on his other arm and his legs also?—Yes.

1506. That was not the only lesion in the body by which the poison might have entered?—Oh, no; he was a beggar, he must have had many a scratch-mark.

1507. Did you examine any of these other scratch-marks for bacilli?—No, not in that patient, but I have done it in a good many others, pimples over various parts of the body.

1508. (*The President.*)—Did you find the bacilli only in the pimple of the particular limb affected?—In the instance, where I found it, on each occasion it was on the limb corresponding to the bubo.

1509. Four cases only?—I examined many more but could not find it at all.

1510. (*Mr. Cumine.*)—Is not there a choleraic form of the plague in which a man appears to have violent cholera?—I have known of one case in which the first symptoms were severe vomiting and diarrhœa; it was not exactly like cholera.

1511. Do you know a case where a man has died of plague when walking along the road?—Yes; I have seen a man coming into the hospital who just came as far as the front door and then fell down dead.

1512. Are not there some rooms in Mandvi well lighted and well ventilated in which repeated cases of plague have occurred?—I have seen that.

1513. As regards the servants on Malabar Hill, they do not live in the bungalow with their masters and mistresses, but in out-houses, do they not?—Yes.

1514. (*Prof. Wright.*)—The plague pneumonia you say is very infectious; is there very much sputum?—In some cases very profuse, a patient would be spitting the whole day long. In the case of Dr. Manser it completely exhausted him. He was continuously spitting the whole day long; the nurse had less sputum. It varied; in some cases there was not very much; it was never at all like the ordinary scanty, rusty sputum of ordinary pneumonia; it was much more than that in every instance; sometimes there was almost pure blood spat up and sometimes it was only tinged with blood, pinkish; sometimes there was a great deal of blood indeed.

1515. Even with ordinary cleanly precautions would it be dangerous to attend the pneumonic cases in Europeans? I understand that the natives spit all over the place, but in the case of Europeans with cleanly habits, do you think there would be so much sputum that one could not manage to deal with it?—It would be on his handkerchief for instance; it may come on his clothing or anything.

1516. I understand that you said the infection did not spread in your hospital when you had the plague patients in; were the urine and the fæces disinfected, or was the fact of non-infection the result of light and air?—In these early cases no precautions were taken at all because they were not diagnosed; but still no spread occurred. At the beginning of the epidemic cases were admitted before buboes appeared, and they might be there two or three days in the hospital before they were diagnosed at all. They were mostly admitted into the best wards of the hospital.

1517. I understand that a man gets the pneumonic form of plague because the people he takes it from have the pneumonic form. Have you seen cases where a man has got the bubonic form too from a patient who has the pneumonic form?—I have seen that too; some members of the family getting the bubonic form and the others the pneumonic form.

1518. Is it difficult to find the plague among other bacteria; when for instance you put the plague bacillus into a mixed emulsion amongst a great many other bacteria, is it difficult to recover it?—Yes, it grows so slowly that all the other microbes have got far ahead of it in a short time and one cannot get it out again.

1519. Is it difficult to recover it even when the percentage of the plague is very great in comparison with other bacteria?—I think in that instance one would be able to get it back if the *post mortem* were made 24 hours after death. In a few instances I had to make it late; it was very difficult to get the plague bacillus at all, because there would be various other microbes growing in the body.

1520. Have you ever been able to find the plague bacillus in the culture when you have not been able to see it previously by the microscope in the fluid from which you make your cultivation? Suppose you make a film from a man's heart after death, and find a few plague bacilli and bacteria; in a case like that would you be able to grow the plague or would the few contaminating bacteria be able to overgrow it?—I think one would be able to recover it then.

1521. But must the plague bacilli be numerous enough to be seen before you can recover them in the culture? I want something to guide us in our researches. Have you a reasonable chance to find the plague bacilli in cases where you cannot see them microscopically?—I have got them from the heart's blood after death; I mean by culture in cases where we could only see one in the field.

1522. Were there any other contaminating bacteria there?—If there was much contamination, I think it would be very difficult to find them.

1523. You think it would be hopeless?—I think it would.

1524. You have spoken of a form of the plague in which you find glands swollen all over the body?—Yes.

1525. Have you any theory as to how the bacteria got in these glands? Are there any points of infection as far as you have been able to judge?—I think it probable that the man's resistance to plague was very weak and that wherever the plague bacilli entered the skin the resistance at the nearest lymphatic gland was speedily overcome and the plague bacilli got into the blood and then got spread all over the body.

1526. Did the plague bacilli get through the lymphatic glands or get into the lymphatic glands from the blood? Do you think it was a case of multiple inoculation?—No. I think it was the case of single inoculation.

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1527. Where they were generalized afterwards through the blood?—Yes, where they easily broke down a man's resistance.

1528. I understand that you got some plague cases without the buboes or high temperature?—Yes.

1529. When the bubo appeared did you take that clinically to be a favourable sign?—No, I do not think so; I think suppuration in the bubo is a favourable sign, because I think that never takes place without the plague bacillus beginning to die in the patient.

1530. Did you ever get plague bacilli alive from the pus when you have opened them?—I never have; I have tried but always failed.

1531. (*Dr. Ruffer.*)—Have you noticed any antagonism between certain kinds of bacteria and the plague bacillus, as, for instance, between the bacterium coli and the plague bacillus?—Yes; that is especially the one that used to bother me in trying to get it out of the body. The bacteria coli used to grow much more quickly than the plague bacillus; and one would often not be able to get the plague bacillus out if they had grown.

1532. Have you ever found the bacterium coli present in the blood during life, or after death only?—I could not say.

1533. Have you made any experiments as to whether the toxines of the bacterium coli have any influence or not on the growth of the plague bacillus?—No.

1534. Have you made any experiments as to the plague being present during life with other micro-organisms in the blood in the glands or any other part of the body?—No.

1535. (*Prof. Wright.*)—Have you ever inoculated with Haffkine's fluid people who have recovered from the plague?—Yes, I have done five or six.

1536. Were those people long convalescent from the plague?—No, the average is about three months.

1537. Did you find the result of inoculation less severe in these than in ordinary people who had not had the plague?—No, I found the same reactions and the same symptoms and the same fever occur in them as in persons who had had no plague at all.

1538. Have you seen the plague recurring in any patients after they had one attack?—There are two cases mentioned in this Report,* but I have not seen them myself.

1539. (*Dr. Ruffer.*)—Mentioned by whom?—It is the Plague Research Committee's Report.

1540. (*The President.*)—How soon before death have you succeeded in finding the bacillus in the blood?—I only found it once, that was about 24 hours before death.

1541. You have had a large pathological experience for a good many years?—I have been nine years making *post mortems* here.

1542. Where is your pathological work being done, at the Jamsetjee Hospital?—Yes.

(Witness withdrew).

MR. R. H. VINCENT, C.I.E., called and examined.

Mr. R. H. Vincent.

5th Dec. 1898.

1543. (*The President.*)—You are now acting as Commissioner of Police in Bombay?—Yes.

1544. You are about to leave Bombay I think?—I am about to leave Bombay in January next.

1545. I believe you have formed some opinion with reference to the origin of the plague in Bombay?—Yes; with reference to the importation of the plague, because I never believed that the plague originated in Bombay. I think it came from elsewhere. Of course opinions were very much divided, some people called the plague "air-borne" and some "heaven-borne," "water-borne," "hell-borne" and everything else, but I came to the conclusion that probably it was brought into Bombay by a gang of Sadhus (religious ascetics) who came here in very large numbers during the months of May, June and July 1896. They came from different parts of India and assembled in Bombay for the purpose of going to Nasik, a very holy place, where every 12 years there is a festival. Off and on, during these months, there must have been more than 1,000 of these people here. They were very filthy objects, most of them, and they lived on the Malabar Hill in the temples. They went about begging all over the town, but chiefly among the Banniahs of Mandvi where we had the first serious outbreak. We had another serious outbreak in the Mahalakshmi temples; these temples are surrounded by about 100 houses, which were entirely forsaken in consequence of the plague in the early part of the epidemic, say a couple of months after the plague took possession of Bombay. The outbreak was very serious there and also in Mandvi. The Sadhus lived in these temples and were with difficulty got rid of from Bombay. They were extorting money right and left. They said "We will not go away until we are paid for going away," and the natives had to subscribe a certain amount of money to get them from here to Nasik, where the festival takes place in August. We ascertained that about a dozen of these people came from Kumaun and thereabouts, and it is my belief that they brought the plague into Bombay, because I remembered that May, June and July had very heavy mortality, and I always held the opinion that the plague did not come here in August, but commenced here in July or perhaps even before.

1546. Did you know of any plague cases among these pilgrims previously to August?—They left in August and there was a case, but before September the plague was not officially recognised as a cause of death in Bombay. It was only in the latter end of September that our attention was drawn to it, and that we began to know that there was plague amongst us, but the mortality in July and August was heavier than it would have been. I remember Dr. Weir telling us that we would have a very bad season sometime in May or June, and then came the plague.

1547. (*Mr. Hewett.*)—I understand that the fair took place in Nasik in August?—Yes.

1548. Was it two months after the end of September or two months after the end of August that the outbreak took place in the Mahalakshmi temples?—Towards the end of December.

1549. It was a long time after the Sadhus had left Bombay?—Sometime after the men had left, but we never knew but that there was plague amongst us all along.

1550. Your opinion is that there was plague at the Mahalakshmi temples as well as Mandvi in the interval?—Yes.

1551. Did these men come from Kumaun?—I ascertained this only of a dozen. I was then ignorant of the plague or anything else. I only spoke to these men because they were in a state of nudity.

1552. You think that a dozen had come from Kumaun?—I think so, certainly.

1553. And the rest from all parts of Upper India?—Chiefly from Upper India.

1554. Have you any reason to believe that the plague is endemic in any other part of India except Kumaun and Garhwal?—I have not.

1555. Do you estimate the number of days journey by train these people would have to take not less than three?—Yes.

1556. And they would have to walk down at least three or four days?—Yes.

1557. Would it not be rather remarkable if they were conveying the plague from Kumaun, that it did not appear on the way?—Except for the reason that it was locked up. I remember a case of the servant of a lady who got plague three weeks after she was exposed to the infection.

1558. Do you know that there was no plague in Kumaun in 1896 before the outbreak in Bombay?—I did not know that; I have been assured that it is endemic there.

1559. That is to say, it occurs at frequent intervals, but there is no regular plague there every year?—Then I was misinformed; I understood it was always present there.

1560. Have you any evidence of plague having been at Kumaun in 1896?—I was under the impression that it was there.

1561. (*Dr. Ruffer.*)—I do not quite understand; these men came here in June, July and August 1896?—They began to come in May.

1562. Was there any plague or a suspicion of the plague during the fair at Nasik in August?—None whatever.

1563. If these people brought the plague in, it is probable that they took it to Nasik?—They came here first, and the persons who brought the plague,—perhaps only a teaspoonful of the bacillus,—might have dropped it here and gone on.

(Witness withdrew.)

(Adjourned to Wednesday, December 7th, at Dharwar.)

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* See Appendix No. XIV in this Volume.

At The Collector's House, Dharwar.

SEVENTH DAY.

Wednesday, December 7th, 1898.

PRESENT :

PROFESSOR T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).
MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.
MR. C. J. HALLIFAX (*Secretary*).

MR. E. L. CAPPEL, I.C.S., called and examined.

r. E. L. Cappel.

7th Dec. 1898.

1564. (*The President.*)—You are the Commissioner for the Southern Division of the Bombay Presidency ?—Acting Commissioner.

1565. And previously to that you had an appointment at Dharwar ?—As Collector at Dharwar.

1566. And therefore you have a very intimate knowledge of the plague in the Dharwar District ?—Yes, the whole of the operations have been conducted under my guidance.

1567. (*Mr. Hewett.*)—I understand that the plague first broke out in the Dharwar district at the town of Hubli ?—Yes.

1568. The next centre of infection was the town of Dharwar ?—Yes.

1569. And it has now extended to a great many villages within the District ?—About 160.

1570. What is the population of Hubli ?—The normal population according to the 1891 census was 52,000, but the population had increased since then to an estimated figure of about 57,000. We estimated that another 5,000 had been added since 1891.

1571. And what is the population of Dharwar ?—Thirty-two thousand in 1891.

1572. The plague has practically died out in these two towns ?—It has died out altogether practically as an epidemic both in Hubli and Dharwar.

1573. Can you give us the total mortality from plague in the town of Hubli ?—The total mortality from plague in Hubli is 2,969.

1574. And in Dharwar ?—Nine hundred and sixty-five.

1575. Can you give us the total number of cases that have occurred in the district, including these two towns ?—Up to the 2nd December we have had 29,102 attacks and 23,577 deaths.

1576. The first case of ascertained plague in Hubli took place in October 1897 ?—October 17th.

1577. Do you think that there were probably cases in the town before that ?—Not in the town, but in the railway chawls.

1578. Do you think that the place was infected from the railway by travellers ?—We know the infection was carried by the railway. So far as any history of the commencement of the infection exists it is through the railway.

1579. Was there anything in the way of an epidemic among rats before it appeared that plague had begun to exist ?—No, there was no indication of an epidemic among rats before the plague actually appeared, although our supervision system had already been working for some time.

1580. Did you have a somewhat sharp outbreak of plague before the close of the year 1897 in these railway quarters ?—The mortality was very small because it was taken in hand at once.

1581. What measures did you take when the original outbreak took place in the railway chawls at Hubli ?—As soon as the first case was discovered I went to Hubli and made inquiries in the chawls, which resulted in the discovery of one or two other cases at once, and in the next few days other cases occurred. Meanwhile we had been watching the town very carefully with a view of seeing whether it was worth while to shut off the chawls from the town. There was no evidence then that the town was infected, and I thereupon drew a cordon of armed police round the chawls at night. The chawl population was a very turbulent one, and we thought it better to do things in that way. The population in the chawls was of a very mixed kind; there were Panjabis and Pardesis, and people from all over India employed in the railway workshops.

1582. Do you think that this cordon effectually prevented the inhabitants of the chawls from communicating with the rest of the town ?—We feel sure it did, because the chawls are only just outside the town and the infection did not take a hold in the town. The original case in the chawls was on the 17th October, and the infection did not take any serious hold of the town till May.

1583. Then the measures adopted for cutting the chawls off from the town were efficient in preventing the plague from spreading in the town ?—Yes, but during the time the chawls were cordoned in that way, several cases of infection did take place in the town from the chawls, because we found that the cordon could not be made absolutely complete and effective. Although we had everything in our favour, there being but a comparatively small area to cordon off, still cases did get through.

1584. Do you think that it is practically impossible to make any cordon quite perfect ?—Yes, we think so. The failures occurred through the default of the police who were working the cordon.

1585. That is in accordance with general experience, is it not ?—That is the only cordon which we have really tried to maintain. We had road posts to prevent intercourse between Hubli and Dharwar except under pass ; these were doing work the whole time. We have also had road posts to guard our frontier against Belgaum. The Belgaum District was of course infected long before this, and those posts undoubtedly did good, because they frightened the plague fugitives from coming in.

1586. After the outbreak had subsided in these chawls there were comparatively few cases in the town of Hubli till about the 15th April ?—Yes. On the 15th April there were only seven cases during the week.

1587. But from the 15th April the plague began to assume more serious dimensions ?—No. At the beginning of May it ran down to nothing ; then towards the middle of May the rain came upon us, and our measures were weakened by the down-pour.

1588. Will you tell us how your measures were affected by the rain ?—We found in heavy rain the supervision system was not as efficient as it was before.

1589. That is the system for finding cases ?—Yes. The supervisors were unable to do their work in pouring rain efficiently. Many of them were volunteers, in fact the great bulk of them were, and they could not do the work efficiently. Then the evacuation measures could not be carried out on the same scale or as completely as in fair weather ; in fact the conditions generally are very much against the success of measures of that kind in the monsoon.

1590. Did it result in delay in evacuating the houses where you ascertained plague occurred, and also in some cases plague escaping detection ?—A good many cases of plague must have escaped us. Of course we had no record of them because they did escape us, but the rapidly growing mortality showed that our measures were not effective, and we could not make them so.

1591. I understand that the outbreak went on gaining strength till about the end of the month of August ?—It did ; that was its culminating point.

1892. And then it went rapidly down ?—It then went rapidly down till it ceased in the middle of November.

1593. When did you first begin to inoculate ?—A large number of our people were inoculated in May ; inoculation on a large scale began in the middle of May.

1594. How many people were inoculated per week at that time ?—I put in a statement which gives details about this and other matters as follows.

Mr. Cappel.
7th Dec. 1898.

HUBLI.

Weeks ending—		Population for the week.	Inoculated.			Uninoculated.	Attacks in—				Deaths in—			
			Once.	Twice.	Total.		Once inoculated.	Twice inoculated.	Unin-oculated.	Total.	Once inoculated.	Twice inoculated.	Unin-oculated.	Total.
Up to June	17	47,427	2,323	531	2,854	44,573	...	1	123	124	...	1	106	107
	24	47,082	3,368	2,220	5,588	41,494	2	1	29	32	2	1	23	26
„ July	1	47,485	4,487	3,956	8,443	39,042	1	...	37	38	1	...	25	26
	8	46,537	5,057	5,460	10,517	36,020	3	3	55	61	3	3	47	53
	15	46,518	5,974	7,289	13,263	33,255	4	2	69	75	4	2	68	74
	22	45,240	6,565	8,959	15,524	29,716	1	6	103	110	1	6	85	92
	29	43,809	9,386	10,311	19,697	24,142	6	9	154	169	6	9	122	137
„ August	5	43,707	10,016	12,660	22,676	21,031	7	9	193	209	7	9	156	172
	12	42,768	11,339	15,845	27,184	15,584	23	14	353	390	5	14	304	323
	19	40,441	10,638	19,839	30,477	9,964	38	31	403	472	30	31	368	429
	26	39,400	10,012	24,600	34,612	4,788	31	35	449	515	21	20	384	425
„ September	2	38,210	9,036	28,160	37,196	1,014	12	20	390	422	8	20	314	342
	9	38,382	7,461	29,334	36,795	1,205	14	33	280	327	11	23	248	282
	16	38,408	6,481	30,911	27,392	1,016	16	39	147	202	15	32	128	175
	23	38,408	6,585	31,680	38,265	143	11	24	99	134	7	19	91	117
	30	39,315	6,839	31,967	38,806	509	5	23	46	74	4	16	37	57
„ October	7	39,500	5,258	33,963	39,221	279	4	11	41	56	4	10	40	54
	14	39,600	5,217	34,527	39,774	200	3	17	14	34	3	15	18	36
	21	39,953	5,286	34,763	40,049	200*	...	6	11	17	...	6	11	17
	28	40,453	4,196	35,040	40,236	217	1	4	3	8	1	4	3	8
„ November	4	40,693	5,100	35,229	40,329	364	...	2	7	9	...	2	6	8
	11	41,164	5,116	35,348	40,464	700	...	2	2	4	...	2	2	4
	18	41,643	5,117	35,397	40,514	1,129	...	...	2	2	...	...	2	2
	25	42,206	5,214	35,558	40,772	1,434	...	...	...	...	...	...	...	...
„ December	2	42,640	5,157	35,959	41,116	1,524	...	...	3	3	...	...	3	3
Average		42,040	...	...	...	...	182	292	3,013	3,487	133	245	2,591	2,969

* The rising figures represented new comers.

[Note.—A corrected statement was put in later by Mr. Cappil, see question 25, 151.]

Mr. Cappell.

7th Dec. 1898.

1595. How many cases of plague occurred among people who were inoculated during the outbreak up to the 2nd December?—Among those inoculated once, 182; among those twice inoculated, 292; among the people who had not been inoculated, 3,013. Those are attacks.

1596. Then the plague was very severe indeed, among the uninoculated people?—Yes. Among those inoculated once there were 133 deaths; among those inoculated twice, 245, and amongst the uninoculated 2,591. The death rate rose at its highest point among the uninoculated to 412 per 1,000 per week, and I find that in the third week of September there were as many as 657 attacks per 1,000 among the uninoculated.

1597. (*Prof. Wright.*)—What of the deaths?—I have not got that figure. Will you permit me to give some other figures which will be interesting to the Commission. I can give you the percentage of attacks to population in Dharwar and in Hubli, and also in the worst infected villages of the district. That will enable a comparison to be made between places like Dharwar and Hubli, where operations have been carried on by evacuation and inoculation, and places where practically nothing has been done, because up to quite recently the villages could not be dealt with owing to the rain.

1598. (*Mr. Hewett.*)—Can you give us the ratio of attacks to population?—Yes. In Dharwar the percentage of attacks to average population is 6, and the percentage of deaths to average population is 4·4. In Hubli the percentage of attacks to average population was 8·6, the percentage of deaths to average population was 7·07.

1599. (*Prof. Wright.*)—I think you told us there were 965 deaths in Dharwar?—Yes.

1600. And that there was a population of 32,000?—Yes. That was the population in 1891. The average population of Dharwar during the epidemic was 21,808, and Hubli 2,040. Those figures may be compared with the virulence f the disease in the larger villages. In those villages, wing to the exceptionally heavy and late monsoon, no vacuations could be carried out. Inoculation of course as out of the question.

1601. Will you please give us the figures for the villages?—I have the figures of four or five typical villages:—

1. Shelwadi, population 4,222; percentage of attacks to population up to date, 32·5; deaths, 27·6.
2. Ibrampur, population 1,716; percentage of attacks 50·4; deaths, 35 per cent.
3. Byahatti, population 3,589; percentage of attacks, 30·5; and of deaths, 21·7.
4. Ingalhalli, population 2,203; percentage of attacks, 47·7; and of deaths, 36·8.
5. Datnal, population 1,280; percentage of attacks 45·3; and of deaths 36·5.

1602. (*Dr. Ruffer.*)—You have given us the percentage of deaths to the whole population, of course?—Yes. The comparison of those figures is very remarkable, and it is rendered still more so by noting the duration of the epidemic. The duration of the disease in epidemic form in Dharwar was 15 weeks, from 19th August to 25th November, of which only three weeks were fair weather; the duration of the epidemic in Hubli was 22 weeks, from 1st June to 4th November, of which practically the whole was in monsoon weather. The duration in these villages that I have noted has been up to date of record from twelve weeks for Nos. 4 and 6, nine weeks for No. 7, and seven weeks for No. 3; so that in a much shorter time you have that enormous disparity in the plague morbidity.

1603. (*Mr. Hewett.*)—What do you wish to say with regard to the theory which has been sometimes advanced that the effect of inoculation is to create a compensating increase of attacks in the uninoculated?—That objection is answered by the figures which I have given. That is the answer which I give to that. It is for the persons who raise that objection to show that the mortality in the towns of Hubli and Dharwar would not have attained a similar proportion to that which it attained in the villages of the same district, and where the conditions were exactly the same. In fact, it is needless to say that in a village the conditions are much better than in towns.

1604. (*Prof. Wright.*)—Can you give us the percentage of attacks and deaths in the towns among the uninoculated?—I will give it to you in this form. The general percentage in Dharwar town of plague deaths to population was 4·4, and I can give you the percentage among the first and second inoculations.

1605. Will you tell us how many inoculated there are? It is a question of knowing the uninoculated numbers?—I cannot work out the average uninoculated population for Hubli now. We have tried to do so but there is a difficulty.

1606. The question is to compare the mortality among the uninoculated villagers with the uninoculated Hubli and Dharwar people?—We tried, but we could not make it out. It always worked out wrong and produced wrong results. We started in June with 44,000 people uninoculated. At the end of October you might put the uninoculated down at about 200. There is always a small margin of uninoculated persons, owing to old age or infirmity or pregnancy among women.

1607. (*Mr. Hewett.*)—Have you the figures to show the average number of uninoculated persons present in Hubli?—Not to give you any fair comparison. I do not think it is possible to work it out.

1608. I do not think you have told us what the number of inoculations in Dharwar town was?—The following figures give particulars about inoculation, *viz.*:—

Mr. Cappel.

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Weekly inoculations and mortality from all causes in Dharwar Town compared with averages during the weeks ending

		August.		September.					October.				November.				December.
		19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2
Weekly population		38,325	*35,552*	33,753	*33,039*	32,619	*30,262*	30,000	*30,000*	12,172	*11,402*	10,863	*9,720*	9,850	*10,081*	10,605	*11,385*
										UP TO WEEK ENDING	IN WEEK ENDING						
Inoculations	Single	...	...	...	...	...	...	...	...	4,926	901	809	827	1,192	584	1,306	1,318
	Double	...	...	...	...	...	...	...	...	3,387	1,001	772	1,165	1,233	718	1,227	827
Progressive total of double inoculations		...	...	...	...	...	...	...	...	...	*4,388*	*5,160*	*6,325*	*7,558*	*8,276*	*9,503*	*10,330*
										UP TO WEEK ENDING							
Plague attacks among	Single inoculations	...	...	...	...	...	...	...	...	45	69	91	106	107	111	115	115
	Double inoculations	...	...	...	...	...	...	...	...	2	9	15	17	22	27	29	29
	Uninoculated	...	...	...	...	...	...	...	...	784	957	1,057	1,118	1,143	1,159	1,169	1,172
										UP TO WEEK ENDING							
Ditto deaths do.	Single inoculations	...	...	...	...	...	...	...	...	15	31	34	37	38	40	42	42
	Double inoculations	...	...	...	...	...	...	...	...	1	1	3	4	7	7	7	7
	Uninoculated	...	...	...	...	...	...	...	...	647	756	827	879	903	909	913	916

NOTE—Average figures are shown in italics.
Actual " " " in roman (ordinary).

Mr. Cappel.

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The total number of persons inoculated in Dharwar up to the 2nd December was 10,330.

1609. That is a considerably smaller proportion of the population than in Hubli?—Yes, because the epidemic in Dharwar took place at the end of the rains instead of at the beginning, and the great majority of people had evacuated the town.

1610. You were able to carry out your other measures more completely owing to the season being more favourable?—Yes.

1611. Although you kept up your evacuation measures at Hubli as far as possible during the rains?—They were carried out consistently. A health camp to accommodate 2,600 people was maintained, and as street after street was evacuated and disinfected the inhabitants were removed to this camp, which was thoroughly comfortable and water-proof.

1612. During the latter part of the epidemic you were able to carry out your measures in full?—Yes, and of course the same operations produced different effects according to the season. When you commence certain operations at a place like Hubli in the middle of the monsoon, the people must wait for whatever you do for them. In another town where the operations take place in different weather, the people will not wait for you but will go out of their own accord. The great majority of people in Dharwar left of their own accord and had not to be evicted at all.

1613. Were they perfectly ready to evacuate their houses at once both in the villages and in the towns?—In view of the operations of the authorities.

1614. Were they afraid of the plague itself?—No, none of them would have moved. They would have waited till they were nearly all dead. They would have moved out in the next epidemic undoubtedly, but they would not have learnt their lesson before.

1615. Was the epidemic in Hubli more virulent than in Dharwar?—I think so; the mortality statistics go to show that. The percentage of deaths to average population in Dharwar was 4·4, whereas in Hubli it was 7·07.

1616. But were not your arrangements for your evacuation more effective in Dharwar?—But this was to average actual population in the town; we take a weekly census.

1617. But assuming that you evacuated the town of Dharwar more effectively than the town of Hubli, might not the fact that you had a smaller percentage of cases in Dharwar prove not that the epidemic was less virulent, but that the arrangements were more effective for suppressing it?—I doubt that. In both of these figures for Dharwar and Hubli we have dealt with the actual population present in the town, and if you find that in Dharwar the plague mortality on the actual population present was only 4 per cent., whereas in Hubli the percentage of the mortality on the actual population was 7 per cent., I think you must draw the conclusion that the plague was of a less virulent type in Dharwar.

1618. What do you exactly mean by the population present in the town?—I mean persons in the town, not segregated outside the town.

1619. Your opinion is that the outbreak was more virulent in Hubli?—Yes. I think the disease more or less exhausted itself in Hubli, and that we got a less virulent type in Dharwar. I think I can show that by giving you the percentage of deaths to attacks in the two towns. Among those once inoculated in Dharwar it was 36·5, and in Hubli 73. Among those twice inoculated in Dharwar it was 24·1 and in Hubli 81. Among the uninoculated in Dharwar it was 78·1, and in Hubli 85·9. The general rate of deaths to attacks in Dharwar was 73·3 and in Hubli 85·1. I should add as regards the figures for Hubli that the percentage of deaths to attacks must not be taken too closely, because the figures arise from a very low proportion of cases to the total inoculations, so that generalisation is not quite safe. Moreover, it is to be remembered that a great many of the people who come up for inoculation come up in the incubation stage of plague; they wait till they feel ill. They are unable to distinguish between a cure and a preventive, and a large proportion of cases among inoculated persons which occur within the incubation period, which we fix at ten days, goes to show that. Dr. Leumann in his inoculation report* pointed out that source of error, but he does not appear to have kept any figures. In Dharwar we have kept accurate figures showing the period which intervened between the inoculation (in the case of the inoculated persons) and the attack, and very valuable results will be obtained from them. But these figures are not yet complete; we have not got the inoculating officer's report.

1620. (*The President.*)—I suppose you will put in that statement?—Dr. Corthorn, who did the bulk of the inoculations here, was asked to write a report some time ago.

1621. Have you a Health Officer either at Hubli or Dharwar?—No Commissioned Officer; a year ago at Dharwar we employed a European soldier as Health Officer in view of the imminence of the plague.

1622. (*Dr. Ruffer.*)—No medical man?—No, we have no Health Officer in that sense; we have no Commissioned Officer of any kind, but only subordinates. It was an advance in itself to get a European private.

1623. (*Mr. Hewett.*)—Who is responsible for reporting deaths in these two Municipalities?—The Municipalities make the returns; all this has been altered now. Since the outbreak of plague, and long before it, we started our supervision system—in April 1897,—under which every case of sickness and death is reported by the ward supervisor. That is our special plague arrangement. Ordinarily Municipal peons are employed who are supposed to ascertain who is dead and who is born, and they bring the information to the Municipal office.

1624. Where the register is kept?—Yes.

1625. Is that Municipal register examined by anybody else?—It is Municipal work; the President and the Vice-Presidents look after these things.

1626. It does not go to the District Officer or his Assistants?—No.

1627. In the villages the Patel keeps the register, does he not?—Yes.

1628. Are these registers subject to the inspection of the Revenue Inspectors and also vaccinators?—Yes.

1629. Are the returns sent to anybody else?—Yes. The whole of the returns are sent to the Deputy Sanitary Commissioner.

1630. To the District Officer also?—No, but the District Officer examines them. The birth and death registers are examined by the special vaccination staff, by the Circle Inspectors, that is, by the Land Record Staff, by the Assistant Collectors and the Collectors when on tour.

1631. Supposing that there was a serious outbreak in any particular village, would any return of it be sent to the District Staff?—Special epidemic diseases are reported; cholera is always reported, and since the plague broke out orders were at once given that the outbreak of plague should be reported in exactly a similar way and on the same form.

1632. Do you have any returns of the normal mortality now?—No, unless it comes in the plague returns.

1633. I mean a return which would come pretty promptly before the District Officer?—No.

1634. There is no means of finding out from any village the likelihood of plague being there?—Not in ordinary times.

1635. At present, say?—At present there is. At present the weekly return of deaths is sent to the Mamlatdar (Native Magistrate) of each village.

1636. And is he responsible for bringing it to the notice of his superior officer?—He knows the population of the village, and he knows approximately the average mortality or what the average mortality should be. Besides that, the Mamlatdar, when he gets these returns, if he finds any ground of suspicion, would immediately visit the village and report to the Collector. The Circle Inspectors have also had this special duty imposed upon them, and have been taken off their ordinary duties for the purpose of going round and examining these death-returns. They send a weekly report to the Mamlatdar, and to their report of actual weekly mortality is appended a return showing the mortality in the corresponding week of the previous year.

1637. So that it ought not to be long before the abnormal mortality becomes apparent?—No. But our system is not very complete. It is a very difficult task. What I have just described is the system which we have now arranged, and which is now being introduced.

1638. Have you received any assistance from native practitioners in detecting cases of plague?—No native practitioner has ever reported a case of plague to me. We do not find that the native practitioners are at all good judges of plague. As a general rule the native Medical Officers fail to diagnose

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* See Appendix No. XV in this volume.

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plague, unless there are buboes present. The pneumonic or septicæmic form they do not seem to understand or recognise, and they invariably attribute those forms to other more common diseases.

1639. Do you consider this to be the most that can be done in order to get any case of abnormal mortality known to the District Staff?—I know of no other way; it can only be ascertained through the village officers and other officers in the way I have described.

1640. (*The President.*)—Where does the return, which the Native Magistrate receives, go to?—It goes to the Sub-Divisional Officer, who is the Assistant or the Deputy Collector. The Sub-Divisional Officer reports to the Collector if there is any ground for suspicion, having in the meanwhile taken action on his own account. Every village in which the plague is actually ascertained to have occurred is immediately reported direct to the Collector.

1641. (*Mr. Hewett.*)—Can you tell us anything further as to the method of the extension of plague?—I think that plague has been carried from village to village by human agency, that it has been carried from district to district chiefly by means of the railway, and that it travels within the limits of any given place by human agency, by the agency of fomites, and I should think by the agency of rats.

1642. It may be conveyed, therefore, by a good many different agencies?—I should say so.

1643. And in this district, in which you have chiefly been able to make observations, what do you think has been the chief channel of communication?—From village to village, I think human agency undoubtedly.

1644. Have you observed that rats have had any share in causing the extension of the disease?—Not in the communication from village to village nor in other communication through the district. The line of rail has undoubtedly carried it largely through the district and from one district to another.

1645. Do you think that contiguity is very apparent in the extension in your district?—Our experience has been that the infection is of a local nature. We have found that the plague has spread from a centre in an extending circle. When Dr. Leumann forwarded his return on inoculation in Hubli, I attached to it an issue of a medical journal published in Bombay—I am not quite certain of the title—which contained an interesting account of a lecture delivered by Dr. Meyer on the progress of the plague in Hubli during the time he was in charge of the flying column. That was illustrated by a small map. The map showed by red crosses and numbers, how and when each case had occurred. These cases were all grouped together, and for weeks, and I may say for months, in Hubli we were engaged in combating the plague in the particular area which was contiguous to the original place of infection in the town itself, and that infection moved steadily on from that centre. We were so convinced of the local nature of the infection that we took the very strong measure of burning down a whole street, which we had ascertained to be thoroughly infected. That street immediately adjoined an extremely populous part of the town, and we recognised that if other measures failed and the plague got into the town, we should have a task before us which no human agency could deal with. We therefore took that very drastic measure of burning the street down. But it did not succeed, and the plague again appeared beyond it. Before we did that, as case after case occurred we used to deal with the patients and with the contacts, and we used to make a large sweep in the locality. We considered that each individual case had infected the locality, and we turned out two or three hundred house-fulls of people for one case. We took the best boundaries we could. Of course there was no scientific means of saying that the infection had gone in a certain direction so far and no further; but we made very large sweeps, and the result of that was undoubtedly to delay the progress of the disease very greatly. We went ten days, fifteen days, and twenty days, and on one occasion twenty-six days, without a single case, and when the disease appeared again it invariably appeared just outside the boundary which we had taken as the limit of our evacuation. Whether the infection is held, and harboured, and carried by rats, or whether it harbours in the infected house-area itself, it is not for me to say; but that does seem to show that the infection is a local one, and that is the theory upon which we are now working in this district, and which I think is practically accepted everywhere as a working theory. When we get one or two cases of plague in a village, we turn the whole village out. Moreover, if the infection were mainly spread by human agency within given town limits, we should expect to find the infection appearing in all parts of the town at the same time, but that was not the case either in Hubli or Dharwar; it spreads very slowly from locality to locality within the town.

1646. (*The President.*)—Do you say you have a map in which you can illustrate that extension?—I have not the map of Dharwar, but we can illustrate it. I must not be misunderstood; of course a stage arrives in the plague, when the epidemic has taken hold, when you cannot say it is here or there; a stage arrives when you give it up; but in the initial stages both in Dharwar and Hubli the infection was confined to one locality, and it spread from that locality steadily until at last it had branched off, and we had lost touch with it.

1647. It spread very much by contiguity?—It appears to me it spread by local infection; how it spread we cannot say.

1648. Do you say you can illustrate that by a map?—Yes.

1649. Will you oblige us by putting in the map?—The map of Dharwar and Hubli will show exactly the point first infected, and then the areas next infected up to a certain day.*

1650. How does this theory apply to the extension of the infection in villages.—There is no contradiction. I think it is a disease of locality, of the inhabited sites, and therefore this theory offers no explanation as to its spread from village to village. I think that must be by human agency.

1651. Having got into a village, it spreads as you have described?—Yes, we have had case after case in this district in which the human agency has been traced. Whenever possible we have traced it; and whenever we have traced the cause from village to village, it has been the introduction of plague by human agency. We have never traced it to the migration of rats, and we have in many cases traced it to immediate importation by human agency.

1652. When you moved the population from a district or a street, where did you send them? How did you dispose of them?—We have health camps established into which people may go without any charge or without any inconvenience. When the people go into the health camps they are allowed to go about their daily business, even in the infected town itself, by day, on the condition that they do not sleep in the infected area.

1653. On what conditions are they allowed to return to their houses?—The conditions vary from place to place; and we are at present feeling our way. The general rule for the district is that an infected house or locality shall not be re-occupied within less than a month after the house has been disinfected and the roof removed; in short when we think things are pretty safe; but we do not encourage people to go in even after a month. We would greatly prefer that they should stay out till the natural agencies of light and air have had full opportunity of operating.

1654. Have you had any bad results from the people returning before the expiration of a month?—They have never been allowed to do so.

1655. Has plague never broken out again on the return of the inhabitants?—We have had no recrudescence of plague any where; but there has hardly been time except in Hubli. I cannot give very valuable information about that, because the inoculation process interferes with any conclusions we might arrive at. For instance in Hubli evacuation, disinfection, and unroofing went on exactly as if there was no inoculation; the people went back to their houses and there has been no recrudescence of plague. But on the other hand the whole population of Hubli is inoculated; and therefore it is impossible to attribute their immunity to the evacuation for a given time.

1656. When you have cases of plague, how are they disposed of?—The patient is always taken to the Plague Hospital, and the contacts, that is, the people living in the same house, are taken to the contact camp, and are not given a free pass to go out till after the expiration of ten or fifteen days, according to varying conditions. At Hubli at one time, when the plague was very bad, we had to make it eighteen days. We found that contacts who had been under observation for eighteen days developed plague. I may add that the patient was invariably accompanied by one or more of his friends or relatives to look after him at the hospital.

1657. With regard to the contact camps, no doubt plague often occurs there?—A great many cases occurred among the contacts.

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* See the record of Mr. Cappel's re-examination on 14th March 1899.

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1658. How are these patients disposed of?—They are taken to the Plague Hospital.

1659. Always? I think to-day we saw some patients who had not been taken to a Plague Hospital, and that is why I ask you. I think cases do occur after the removal to the contact camp and we found those patients remaining in the contact camp?—You found plague patients in the contact camp?

1660. (*Mr. Hewett.*)—You are referring to the town, are not you?—Yes. I did not understand that you were speaking of the villages. In villages they do the best they can. When plague has occurred in a hut the people are helped as far as possible to move out of that hut, to burn it down, and to shift their quarters.

1661. Your statement about the plague cases being taken to hospital refers to town?—Yes; there are no hospitals for the rural areas.

1662. (*The President.*)—In the rural areas they are simply removed to another tent?—When a village is evacuated, it means that the people are urged to go out of the infected village and to make their own arrangements outside, which they are very well accustomed to do in fair weather. If they get plague in their temporary habitations, they are advised to move their habitations or destroy them.

1663. What is the arrangement with regard to the medical treatment of the patients?—There is none in the villages.

1664. When they are affected with plague?—In villages around Hubli and Dharwar as much medical attendance has been given as is possible; but in the large areas of India it is impossible to provide medical attendance. I want to mention one thing. The working theory of local infection which I referred to was published under a Government Resolution of October 1897. That theory was stated by Major Anderson, I.M.S., who is now working in this district. In Major Anderson's statement the theory of local infection, and the necessity of moving out the whole population of a village in which a single plague case has occurred, was stated. That was published in the Government Resolution of 25th October 1897. I wish to say that because I wish to explain that I was not claiming the theory as my own.

1665. (*Dr. Ruffer.*)—You have given us some figures as to the number of people in Hubli and in other places; can you tell me how you obtained this census. I have before me the total weekly figures, that is, the number of people week by week in Hubli. How are these figures ascertained?—By the supervisors. Each supervisor has a ward composed of 100 or less houses. And he has a census form or register which was originally filled up, when the system was started, containing the names of every person in each house.

1666. (*The President.*)—He goes round every week?—Till the plague became endemic we accepted that census as first taken for the purpose of supervision. When plague became endemic in Hubli and Dharwar we proceeded to correct that census weekly. The men go round and make inquiries in every house.

1667. (*Dr. Ruffer.*)—You gave us some statistics; for instance, you say plague began in Hubli, I think, in June?—It became epidemic at the end of May.

1668. Had you noticed a rise in the mortality for some time before: have you any figures as to that, say, for five months before or as compared with the corresponding period in the previous year?—The average weekly mortality is recorded. The plague became epidemic in Hubli town in May, so we can give it to you for six months before.

1669. In these villages which you have mentioned, was there any rise in the mortality in the months preceding the plague?—I do not know that; but that information can be obtained. I have no hesitation in admitting that plague was probably there before we found it out.

1670. How did you find out that the plague was present in the villages?—It was reported by the village officers to the Mamlatdar.

1671. Did he report the case as plague?—I think it was merely returned as suspicious mortality. In many cases we sent the Mamlatdar to the spot. We found the mortality was rising and we sent the Mamlatdar to the spot to make inquiries and we found almost invariably that it was plague.

1672. In your evidence you said that in a certain number of villages the length of time during which plague raged was so much?—Yes.

1673. Then those figures can only be approximate?—We can only give you the figures which we have. The same thing applies to all our figures. One of the first things said was that plague had undoubtedly appeared in Hubli before we knew of it, and I believe that is the case everywhere; I believe we never got the first case; we certainly did not in Dharwar.

1674. Now about the vaccinators; are they medical men?—No.

1675. Assistant Surgeons?—No, only trained vaccinators. They never practise as medical men in any other respect.

1676. In the village which we saw this morning, the people were going to be allowed to return to their houses in June; they will have to go back before the next monsoon?—Yes, it is up to that date I wish them to stay out.

1677. You said that in towns measures of disinfection were applied before the people returned to their houses?—Yes.

1678. What are the measures of disinfection which were applied at Hubli?—You can see it in Dharwar here.

1679. Can anybody give evidence on that?—Major Hardy is in charge of disinfection in Dharwar, and he will give evidence on the subject and explain the process.

1680. In this village close by, will the houses be disinfected before the villagers are sent back?—It depends upon our available staff. Our staff is not of much use unless it is supervised by European agency or perhaps by higher native agency; in any case disinfection is not a thing to be relied upon, unless you have some person who understands that sort of thing and whom you can trust to do it. In the villages we find it very difficult. In the Hubli taluka we are sending some of the trained disinfecting staff from Hubli town to carry out the disinfection in the villages. In other more distant villages we rely upon the Mamlatdars and their staff to do what they can in the way of disinfection, but it is not very much. They have pumps and they have corrosive sublimates and each Mamlatdar has a number of assistants who have been trained in disinfection. Our chief reliance is on the unroofing of the houses.

1681. In a great many instances the villagers would go back without their houses being disinfected?—Yes, provided always the houses had been unroofed for a sufficiently long time.

1682. When do you begin unroofing the houses?—As soon as we can get the people out. We encourage the people to unroof their own houses, and point out to them that the sooner they unroof them and the more thoroughly they do it, the sooner they can go back.

1683. Could you give us some evidence as to the mortality in segregation camps and contact camps?—The mortality in the health camps is very small.

1684. We shall be able to get the figures elsewhere?—The plague morbidity among the contacts is sufficiently high naturally, because they come from infected families. I can give you for instance the figures of our hospital contacts. The hospital contacts are either the patient's friends or members of his family who have been living with him, and who attend him to the hospital. In the last hospital return for Dharwar dated 6th December, we found 32 cases of plague among hospital contacts.

1685. How many contacts were there?—I am afraid that figure is not here. Of the 32 cases, five occurred after ten days in hospital, and may fairly be held to have been infected at the hospital. That leaves 27. I cannot give you the proportions.

1686. You have had a great deal of experience with regard to Haffkine's inoculations?—I have seen a great deal of that.

1687. I understand when a man was inoculated twice you gave him a pass enabling him to go away?—Yes.

1688. Have you found as a matter of fact that a great many people who were inoculated availed themselves of that permission?—Undoubtedly they do. We found in Hubli, and we have proved and you will find the proof in Dr. Leumann's inoculation report* for Hubli, that the proportion of inoculated persons who left Hubli was much less than the number of uninoculated persons.

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* See Appendix No. XV in this volume.

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1689. Did you find any difference in the social status of the inoculated and uninoculated; did you find for instance that the better classes got inoculated and the lower classes did not?—None whatever; because we have inoculated the whole population, both in Dharwar and in Hubli.

1690. I think in your evidence you said a certain number of people did not get inoculated, the sick and the aged?—The Medical Officers did not inoculate persons with certain diseases, persons who were in a weak state or suffered from diabetes, or anything of that kind.

1691. Have you the number of the sick?—I can give you the actual figures, and then you can take that.

1692. The number of people who were not inoculated because of sickness? Because they were actually ill at that time?

1693. Yes, and for reasons of health; for instance, pregnant women?—I can give you the actual figures up to date in Hubli and Dharwar. This forms part of our weekly report from Dharwar.

1694. I want the actual figures not of people not inoculated, but of people uninoculated on account of health?—Seven hundred and sixty persons in Dharwar. In Dharwar the present number of uninoculated people is 1,866; out of those 760 have been exempted either because they have had plague, or because of ill-health or old age.

1695. Have you figures for Hubli?—We have only kept figures for Dharwar; we have been returning these figures for several weeks to the Government as a matter of interest.

1696. (*Mr. Cumine.*)—In addition to ordinary monsoon rains, you get thunderstorms in April?—In April and May.

1697. And do you not get thunderstorms in November?—Yes; this year the late rains were exceedingly heavy.

1698. So that the difficulty of getting people out and keeping them out would be far greater in the Southern Mahratta country than in Poona for instance?—Yes, much greater; you have certainly three months more bad weather to deal with.

1699. Do you think the epidemic is dying out in the villages now, or as it ceases in one village does it go to another?—The number of infected villages is gradually spreading up to date; but the number of cases has taken a distinct turn for the better. The results of evacuation are very well marked; and in the talukas where evacuation has been carried out most completely, the number of cases is falling in a still more marked manner. The following table gives weekly particulars, *viz.*:—

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Talukas.	1897.											1898.																																																					Total.
	During the weeks ending											During the weeks ending																																																						
	October.		November.				December.					January.				February.				March.				April.					May.				June.				July.					August.				September.					October.				November.				December.					
	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	
																																												ATTACKS.																					
Dharwar	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	...	2	...	15	24	40	55	102	119	129	187	201	201	169	138	143	149	270	341	...	...	...	...	2,2
Hubli	4	4	10	8	6	...	2	2	3	2	...	1	2	2	...	2	1	1	...	...	3	4	1	...	...	2	6	2	1	1	3	5	14	25	14	32	38	61	75	110	170	209	439	570	867	679	1,013	1,055	856	1,621	1,053	891	794	596	558	590	460	304	292	...	...	...	...	13,46
Bankapur	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	65	154	80	131	65	137	118	180	154	171	170	191	44	...	...	...	...	1,66
Kalghatgi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	1	...	1	27	16	92	71	85	115	172	113	203	175	108	75	...	...	...	...	1,25
Navalgund	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	2	...	...	2	3	3	13	59	213	573	833	989	924	863	937	610	...	...	...	...	6,02
Ron	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	2	...	2	5	...	2	23	19	99	201	257	158	371	250	178	262	...	...	...	...	1,83
Gadal	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	218	42	28	165	142	74	99	132	124	205	166	174	253	222	264	248	...	...	...	...	2,56
Total	5	6	10	8	7	1	2	2	3	2	...	1	2	2	...	2	1	1	...	...	3	6	1	...	1	2	6	2	1	1	3	5	14	25	14	32	33	62	77	112	170	212	446	810	934	755	1,306	1,483	1,150	2,108	1,586	1,750	2,207	2,373	2,284	2,655	2,239	2,252	1,872	...	...	...	...	29,10
																																												DEATHS.																					
Dharwar	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	2	...	11	20	39	46	96	82	86	158	159	148	128	108	113	135	210	266	...	...	...	...	1,818
Hubli	3	3	6	7	6	4	4	2	3	1	...	1	2	2	...	2	1	1	...	...	3	4	1	...	...	1	5	1	1	2	3	5	13	19	15	26	26	53	54	92	138	172	357	496	655	511	841	837	709	1,374	924	757	673	440	357	483	406	259	245	...	...	...	...	11,00
Bankapur	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	40	121	71	101	61	97	117	119	95	135	143	147	37	...	...	...	...	1,287
Kalghatgi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	1	...	1	15	11	57	81	83	87	139	97	165	145	96	75	...	...	...	...	1,056
Navalgund	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	2	...	...	1	3	3	11	33	133	479	709	717	770	718	696	555	...	...	...	...	4,831
Ron	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	2	...	2	5	...	2	9	14	68	141	211	154	355	231	175	217	...	...	...	...	1,594
Gadal	...	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	153	42	25	130	128	86	83	94	104	173	118	120	192	159	188	191	...	...	...	...	1,990
Total	3	5	6	8	6	6	4	2	3	1	...	1	2	2	...	2	1	1	...	...	3	6	1	...	1	1	5	1	1	2	3	5	13	19	15	26	26	54	55	92	139	174	364	667	718	580	1,064	1,200	964	1,721	1,365	1,401	1,818	1,864	1,648	2,213	1,937	1,771	1,586	...	...	...	...	23,577

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Last week there were 2,200 cases, and this week only 1,800. We could have obtained that result long ago but for the perpetual rain. The result of the evacuation is very quick to show itself.

1700. In Bombay the period favourable for the epidemic seems to be the cold weather, whereas in Karachi the last epidemic came in the hot weather. The heat did not seem to interfere with it in Karachi. Have you any idea which is the most favourable season for it in this part of the country?—We have no experience. Our epidemic so far has been confined to the rains and to the present cold weather epidemic, which is not complete.

1701. As regards the spread of the epidemic in Hubli, it first of all invaded the parts of the town close to the railway chawls, did it not?—Yes.

1702. And then it spread from there?—Yes.

1703. Was it preceded by any movement of rats?—We had no history of rats preceding the epidemic.

1704. If a man were attacked to-day, say, could you trace the fact whether he had gone to see some sick person about three or four days previously; does it appear to be carried by relations or friends who have gone to sit by sick people?—We have no history of that kind of infection. We know that persons have carried infection by going from one infected part of the town to another, but the actual contact does not seem to cause much infection. The statistics of infection of hospital contacts are very satisfactory. I believe only two cases occurred at Hubli among the actual hospital attendants who were with the patients day and night, and we have only five cases to account for in the Dharwar hospital among the people who stayed and slept all night long by the bed-sides of the patients.

1705. When you evacuated that part close by the railway chawls, you took out sometimes hundreds of families at a time?—Yes.

1706. Then there was a lapse of several days and a case appeared just outside?—Generally very close outside our limits.

1707. Does that look as if the infection crept along gradually of itself through the evacuated part?—I am not prepared to say.

1708. (*Prof. Wright.*)—Did the cases you speak of occur before the people came back to their houses?—Yes.

1709. Were the people visiting their houses all the time?—No. In the early stage at Hubli, when the houses were evacuated, they were immediately screwed up in order to prevent the people going in, and guards were placed to keep the people out of that locality.

1710. (*Mr. Cumine.*)—Would the re-appearance of a case just outside the evacuated circle appear to show that partial evacuation of a particular division of a town is useless?—That is the conclusion that I came to, assuming that infection has taken strong hold. I think in certain places, such as Ahmednagar, where the disease has died out or has been killed by the process of partial evacuation without spreading further in the town after a comparatively short run, the explanation is that the infection was not very deep and that favourable circumstances were present. If you get a few cases on the outskirts of a town which has a more or less a natural division, or in similar places, I can understand that partial evacuation would succeed, but if you get a case or two in a homogeneous part of a large town, our experience seems to show that infection will not be got rid of by evacuating certain streets or quarters.

1711. Now as regards darkness, what effect have you observed that had; did you find most of the cases occur in dark rooms or in well-lighted rooms?—In this part of the country the houses are all dark; the inner rooms of all the houses are absolutely dark, so much so that you cannot see your way. When the first case occurred here in Dharwar I went down to the town, and they said there were some people who were sick in a certain house. I went in and fell over a dead body: and getting a light we discovered another dead body. There are no windows, no light, and no ventilation.

1712. The rooms are as a rule very much worse lighted than in Bombay?—There is no lighting, there is midnight darkness throughout the house when you have once entered the door.

1713. (*The President.*)—That is in the town?—In the towns and villages; that is the habit of the people here.

1714. (*Mr. Cumine.*)—Do you remember which caste had it worst in Hubli or Dharwar: what particular set of people?—We might work it out, but it would lead only to a doubtful conclusion.

1715. It was not strikingly prevalent amongst one set of people?—In Hubli it began among the Musalmans and in Dharwar it began among the Kakas; they are also Musalmans, but a particularly low caste; and in Belgaum it began among the Kakas.

1716. Did it then go to a caste which is connected in some way with the Musalmans?—No; the spread was from within outwards irrespective of caste. We never had any indication that it went in that way.

1717. In some towns it has been observed that if it gets into the trading classes, it then goes to the Pardesis who are the servants of the traders, and it goes also to the Hamals who are the porters of the traders. In the spread of the infection has any such inter-connection of castes been noticed in Hubli or Dharwar?—No, we have not traced anything of that kind.

1718. I think you said that when the epidemic was at its worst two out of every five people in the town got plague or died. Was that among the uninoculated?—That was in Hubli.

1719. As a fact in any town or village where inoculation has not been tried at all, has any such death-rate been noticed?—I think it comes to more than that; the villages of which I gave full statistics came to much more than that. The percentage of attacks at Ibrampur was 50 per cent. and the percentage of deaths was 35 per cent. in 12 weeks.

1720. This rate which you mentioned among the uninoculated, about 400 per thousand, is that the rate of deaths or of attacks?—Deaths.

1721. Did the better class of people who lived in better houses come forward first to be inoculated or did common people come, or is it impossible to say which came first?—We may say that the better class of people came forward first, because the administrative officers urged them to set an example, but from the first the low class people were induced to accept inoculation.

1722. Were the people who came first to be inoculated people in whose families plague cases had already occurred, and therefore whom plague might have attacked if it had wished to do so?—Do you mean the people who were frightened by the occurrences of plague in their families?

1723. Did it happen that in a house of five people three people got plague and died, and the remaining two who were not affected came to be inoculated?—I cannot say that the first persons to come forward for inoculation were persons who came forward under that fear at all.

1724. They were not people whom the plague had passed by, who had been left behind by the plague as it were?—No.

1725. I wish to see whether they had immunity or not already, and that is why I ask the question. If the plague had been in the house and not chosen to attack them, we might assume they were immune.—In any case both in Dharwar and Hubli the whole population has been inoculated, immune or not immune. I may say again we can supply you with any number of instances in which the uninoculated members of a family have all died and the inoculated members have not died. Dr. Leumann has appended a history of sixty such cases to his inoculation report* for Hubli. These cases were selected out of 200, picked and chosen for him by Mr. Keelan, who was the first Superintendent. He selected only sixty and he has appended a history of these cases to his inoculation report. I can give you a very striking case from Dharwar, the case of Mr. Shelke, a clerk in my office. There were thirteen members of his family all living together and four children were inoculated. These four children are living and well up to the present day, while all the remaining nine members of the family, including Mr. Shelke himself, who was a Government officer, a well educated man, of good family, are all dead. Mr. Shelke himself, after losing various members of his family, was finally broken down by the death of his son, after which he became quite mad and broke into my office and made a tremendous scene. We had to put him in a separate hut by the Plague Hospital, and afterwards we took him to the Lunatic Asylum, and the poor fellow developed plague after he had been there for two days. There was an end of that family except the four members who had been inoculated. Hundreds of such instances could be given, and, as I said, Dr. Leumann has appended sixty cases.

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* See Appendix No. XV in this volume.

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1726. (*Prof. Wright.*)—How do you determine whether a dead man belongs to the inoculated or uninoculated class?—We make careful enquiries about it. Every inoculated person gets a certificate; we give a certificate for double inoculation only, but even if a man has only been once inoculated he gets an inoculation check which is a warrant for his first inoculation, so that the cases are very easily determined. If we find a dead body, and he has no paper on him, a little enquiry will generally show who he is. The tendency of the people, so far as there is any evidence in the matter, would be to emphasise plague cases among the inoculated; the margin of error is likely to be on the other side. Every one is very anxious to say. "Here is an inoculated man who has got plague," and it is nobody's interest in particular to point out an uninoculated man who has got plague. That point is also dealt with in considerable detail by Dr. Leumann in his inoculation report * for Hubli.

1727. (*The President.*)—You were asked some questions which make it advisable that we should have a return, which I am not quite sure you can give to us, of the percentage of attacks and deaths in Dharwar and in Hubli among the uninoculated alone?—I have worked out the percentages of plague mortality on the average uninoculated in Hubli and Dharwar. They come to 9·01 in Dharwar and 14·5 in Hubli.

1728. (*Prof. Wright.*)—You said that the objection against plague inoculation, which was based on the ground that there was an excessive proportion of attacks among the uninoculated in Hubli, falls to the ground because in villages outside a larger percentage of mortality has occurred among the uninoculated than among the uninoculated who remained in Hubli. Is that consistent with your statement that 60 per cent. of the uninoculated in Hubli were attacked by plague?—Yes. I should explain that 60 per cent. plague morbidity in one week was on a very small number of uninoculated persons remaining behind. As a matter of fact it was on an uninoculated population of only 1,016. The plague mortality worked out on the average uninoculated population at Hubli comes to 14·5.

1729. You mean then that, taken as a whole, the mortality among the uninoculated in Hubli is less than half that recorded in the villages?—Precisely; and for Dharwar 9·01.

1730. In the case of Hubli were the weeks in which you had a mortality of 60 per cent. and 40 per cent. among the uninoculated, weeks which were attended with greater emigration of people?—They were.

1731. Do you think then these figures are explained by the fact that the healthy people emigrated and the sick remained behind?—I do not think there is anything to show that they did emigrate; in fact we know that they did not—not in a sufficiently large number to afford that explanation.

1732. You cannot suggest any reason for these particular weeks having been so fatal for the uninoculated?—No. The epidemic was just topping its rise then. It attained an unexampled severity in Hubli and the figures are, as aforesaid, on comparatively small numbers. The 40 per cent. was only on 1,200 uninoculated and the 60 per cent. was only on 1,016.

(Witness withdrew.)

MISS A. M. CORTHORN, M.B., called and examined.

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1733. (*The President.*)—You have been in this district for some months?—Since the middle of August.

1734. You are a medical practitioner, I understand?—Yes.

1735. What qualifications have you?—M.B., B.S. of London.

1736. (*Prof. Wright.*)—I think you have had special experience of the plague; you had some special experience in Bombay first?—Yes; from March to the end of May, until the Parel Hospital closed, I was in charge of the women's wards there.

1737. Then you came down here to inoculate railway employés?—That was in August; in the interval I worked in M. Haffkine's laboratory in Bombay.

1738. You did not confine your work to the inoculation among railway employés, but you generally inoculated any one who came in from the town?—Yes; at Hubli I did railway people especially, but I also did a good number of people in the town, and at Dharwar I have always worked among the people in the town as well as the people in the railway.

1739. How many did you inoculate in Hubli?—I should think I did about 3,000 altogether. I was helping Dr. Leumann a good deal and Dr. Chenai, and I did not keep a separate register of my own, so that I cannot say definitely.

1740. In Dharwar?—In Dharwar I did between 15,000 and 16,000.

1741. And in Gadag?—About 7,000.

1742. So that you have done about 25,000 in all?—Yes.

1743. What about the method of standardising the vaccine; did you find any trouble in applying M. Haffkine's prescription?—No. I think if you keep to his printed directions on the bottle and observe carefully the arms of those who come to you for second inoculation, you can feel fairly certain that you cannot go wrong in applying the dose. If occasionally you find the arm continues inflamed rather longer than it should be, then you lessen it.

1744. Have you ever, when you gave the full dose mentioned on the bottle, seen too violent symptoms result?—On one occasion I saw a temperature of a little over 104, which lasted only a few hours; that was after a full dose. It was on the second dose given. But as a rule I have always felt that I could give above the full dose. I have generally seen that I could give a fifth or a sixth above the dose without getting too severe re-action.

1745. Have you had to increase the dose in any case?—Yes; when I first came here and at Hubli I found I was not getting a sufficiently strong re-action, and then I gave more, and I believe Dr. Leumann did the same thing. I did it first of all on his suggestion at Hubli, and I found that I could do it quite safely. I experimented at Hubli, because I was able to watch the cases after I inoculated them directly. Here I could only watch them by seeing under what conditions they came up for the second inoculation, but in Hubli I went and saw the patients the day after inoculation.

1746. Where did you make the inoculation?—In the left arm.

1747. Have you inoculated in the flank?—Only very occasionally, when for some reason the arm has not been right or a baby has been a little unmanageable, and I could get hold of its flanks a little more easily.

1748. How do you gauge the dose for babies?—I have found the children stand a stronger dose altogether in relation to their size. One does not follow the ordinary rule for administering drugs to children. One gives larger dose proportionately to the weight.

1749. How long after did you make the second inoculation?—From seven to ten days; I do not like to give it under a week. I find the arm is rarely fit for second inoculation under a week, but frequently it is ready at the end of the week. I do not like to put it off later than ten days if one can do it, but occasionally the arm comes up too inflamed at the end of ten days for a second inoculation, and in those cases I tell the patients to come back at the end of a fortnight. I should say that from a week to ten days is the time suitable in the large majority of cases.

1750. Do you increase the dose for the second vaccination?—No.

1751. You use the same dose?—Unless I can elicit from the patient that there has been absolutely no re-action. Supposing a patient comes to me four days after the first inoculation and I see that the patient has not been ill at all, then I give a bigger dose the second time.

1752. Do you take any precautions against producing abscesses in these inoculations?—I take all the precautions I can in the stress of work. I always boil my syringe. I did not do that in Dharwar, but just at the end of my time in Dharwar I got a small crop of abscesses which I did not get before, and that led me to increase my precautions. Now I boil my syringe always before using it: and I also boil the needles, and the tube with which I draw the serum out of the bottle. I work with two needles always and sometimes with three. I keep the needles lying in a basin of strong carbolic lotion. It is made up nominally of one in forty, but it is generally one in thirty. I inoculate with one needle, and as soon as I have closed the puncture with my finger, I take the needle out of the syringe and put it in the basin and inoculate the next patient with the second needle, leaving the first needle lying in the carbolic till I am ready for the third. I do sometimes ring the changes on three or more needles.

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* See Appendix No. XV in this volume.

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1753. Have you in spite of these precautions ever seen abscesses produced by these inoculations?—I have had three abscesses at Gadag since I have been there, and I have taken the precautions ever since I was there with the exception of the first day. I have not been able to elicit from the patients which of the places they were done at: so I do not know whether it was before I boiled my syringe or not. The patients came in a very dirty condition. The women drop their dirty saris over their arms directly one has inoculated. And if one has not closed the puncture at the time a certain amount of contamination may enter through the puncture

1754. Have you any reason to suppose that the abscesses are due to the prophylactic?—If the prophylactic is used without care being taken to determine its condition first I do not think so; I have had to throw away certain bottles.

1755. How do you test the bottles?—By smell.

1756. How do the bottles smell when they come from M. Haffkine?—When I have taken a bottle out of the box before the morning inoculation, on opening it I sometimes found it smelt. I will not use at the afternoon inoculation the bottle which has been opened at the morning inoculation.

1757. When you say that some bottles smelt it may be due to something which has happened on the railway journey?—Yes, or in the laboratory; the sealing wax may not have been uniform or it may have bubbles in it, and air might find its way into the bottle in that way.

1758. Are the inoculated different with regard to their social condition from the uninoculated?—That depends entirely upon the period at which we are taking inoculations. When you first begin to inoculate you will find people of better social condition coming up, but as soon as the inoculations have taken place for a short time you will find the poorer classes coming up. For instance, in Hubli and Gadag at the present day there is absolutely no distinction: they are all struggling alike for inoculation,—all castes and classes.

1759. At the beginning there was a social distinction with regard to inoculation, and now there is no social distinction. Is there a distinction as regards health; do you inoculate the sick as well as the healthy?—No; if the persons coming to me were obviously old and infirm I tell them that I think they had better not be inoculated. I do not know of any case, but cases have been reported to me vaguely of old people who have never got over inoculation. I do not know personally of such a case, but at the same time I think it may be so, and I do not expose a very infirm old person to the shock of the sharp fever which one gets in the re-action.

1760. What do you do with regard to the phthisical patients?—I do not inoculate them; and I do not inoculate diabetic patients: I have excluded those. I have been afraid of inoculating diabetic patients myself; I believe M. Haffkine does inoculate them with small doses.

1761. What do you do with people who are suffering from the first symptoms of plague,—with a bubo?—I should not inoculate because I should think they had better be nursed for their plague; going through the plague will do the same for them as inoculation.

1762. Then you exclude the very old and those that have diabetes and phthisis and marked plague?—Yes.

1763. What steps did you take to find whether inoculation protects people against plague?—I have kept a register as accurately as I could of all the people inoculated; I have kept in touch with the medical officer at the hospital and I have examined the returns of all the patients going into the hospital who were returned as being inoculated. And I have also got the authorities where I have been at work at different centres to tell me of any people they know whom I have inoculated who have got plague. I have also got, where possible, the inoculation check returned, and entered in the register all the people that I could get hold of whom I have inoculated who have developed plague afterwards. Of course I have missed a good number, but I think I have obtained very fair results. I have got hold of the larger part of the people who have developed plague. The weekly census has been taken in Dharwar since October 19th, which has given not only the total population, but has given it under the headings of uninoculated, once inoculated, and twice inoculated. I have got hold of all the cases that I could each week; and I have worked out week by week the percentage of morbidity and mortality on that weekly census. I have done it also on my register and compared it with the average population; and I have also done it week by week on the numbers given in the census of the inoculated and uninoculated in the town.

1764. Is there any difference in the number of inoculated in the census and in your register?—Yes, a number of those whom I have inoculated have gone away, but a much smaller proportion of those have gone away than of the total population. For instance, the population on August 19th, 1898, was 38,325 and on November 2nd, 9,720.

1765. What is the emigration among the inoculated?—On November 2nd, 12·76°/o of the uninoculated remained, 79·3°/o of the twice inoculated and 50·38°/o of the once inoculated.

1766. Is there any difference between your register and the census?—The census stated that there are only so many inoculated people in the town: therefore the other people have gone away.

1767. Or the census is incomplete?—Yes, but I think the census has been taken fairly accurately on the whole. Of course I do not say it is absolutely correct, but I think it is correct within a few hundreds.

1768. You think the uninoculated went out because the population went down?—Yes, from 38,000 to 9,000.

1769. Can you tell us what was the fate of those that remained in the town who were inoculated and uninoculated, leaving aside this emigration question?—Taking those that remained in the town on October 19th, I work it out that out of 5,748 uninoculated people there were 168 cases of plague with 124 deaths, giving percentages of 2·9 and 2·15; of the 3,542 once inoculated there were 17 cases and 7 deaths, that is, 17 against 168 and 7 against 124; which I work out means a reduction of morbidity by 83·5 per cent. and reduction of mortality by 90 per cent.

1770. Have you worked out figures for the twice inoculated?—Taking the twice inoculated cases for that same week, there were 2,112 in the town, and we had one case and one death, which work out at the percentage of ·047, a reduction of morbidity 98 and reduction of mortality 99 per cent. That was for one week, and I worked it out week by week.

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1771. (*The President.*)—Perhaps you will kindly hand that paper in?—Yes it is as follows:—

Statement from weekly reports of influence of inoculation upon plague incidence as shown in reduction of morbidity and mortality of the inoculated.

Week ending.					
19th October 1898		Uninoculated.			
	Population	5,748			
	Plague incidence	Cases.		Deaths.	
		168		124	
		Once inoculated.		Twice inoculated.	
	Population	3,542		2,112	
	Plague incidence	Cases.	Deaths.	Cases.	Deaths.
		17	7	1	1
	Reduction of morbidity	83·5%		98%	
	Reduction of mortality	90%		99%	
26th October 1898		Uninoculated.			
	Population	4,200			
	Plague incidence	Cases.		Deaths.	
		100		71	
		Once inoculated.		Twice inoculated.	
	Population	3,535		2,428	
	Plague incidence	Cases.	Deaths.	Cases.	Deaths.
		20	6	8	1
	Reduction of morbidity	74·3%		86%	
	Reduction of mortality	89·9%		97·56%	
2nd November 1898		Uninoculated.			
	Population	3,089			
	Plague incidence	Cases.		Deaths.	
		61		52	
		Once inoculated.			
	Population	3,074		3,557	
	Plague incidence	Cases.	Deaths.	Cases.	Deaths.
		15	3	2	1
	Reduction of morbidity	75·28%		97%	
	Reduction of mortality	94·24%		98·5%	

Statement from weekly reports of influence of inoculation upon plague incidence as shown in reduction of morbidity and mortality of the inoculated—contd.

Week ending.					
		Uninoculated.			
9th November 1898	Population	2,276			
	Plague incidence	Cases.		Deaths.	
		25		24	
		Once inoculated.		Twice inoculated.	
	Population	3,184		4,290	
	Plague incidence	Cases.	Deaths.	Cases.	Deaths.
		1	1	5	3
	Reduction of morbidity	97·7%		89·4%	
	Reduction of mortality	97·7%		93·4%	
		Uninoculated.			
16th November 1898	Population	2,132			
	Plague incidence	Cases.		Deaths.	
		16		6	
		Once inoculated.		Twice inoculated.	
	Population	3,018		4,931	
	Plague incidence	Cases.	Deaths.	Cases.	Deaths.
		4	2	5	...
	Reduction of morbidity	82%		86·48%	
	Reduction of mortality	82·3%		100%	

1772. (*Prof. Wright.*)—Perhaps you will tell us about the inoculation of people incubating plague ; does it hasten their deaths ?—I do not think it does. I find that of the whole number of people inoculated 50 cases developed plague within seven days of inoculation, and I take that as well within the period of incubation, thus giving only a case mortality of 33·3 per cent., which is distinctly lower than the ordinary mortality. The mortality for the whole town is 70·3 per cent., that is, up to the time of my leaving Dharwar, November 16th ; for the hospital I know that Dr. Hornabrook has had much lower than that, but that is the mortality of the town.

1773. Taking the inoculated during the first few days of inoculation, did they present more resistance ?—In working out these it struck me that the resistance seems to increase towards the end of the month ; but you see the figures are not very large. For instance, taking 50 cases which developed plague within seven days, we had a case mortality of 33. If we go on to ten days, then I had 69 cases which developed plague within ten days of inoculation, and they had a case mortality of 31·8. Then I go on and find that up to about a month on the whole the deaths seem to get less ; for instance, I had three cases which developed plague on the eleventh day with no death ; eight cases which developed plague on the twelfth day with two deaths ; two cases on the thirteenth with no deaths ; four cases on the fourteenth, one death ; one case on the fifteenth with no death ; two cases on the seventeenth with one death ; four cases on the eighteenth with no death ; and two cases on the nineteenth with one death.

1774. How soon does the liability of taking plague decrease; does it decrease the next day after vaccination ?—Yes. I have a great number of cases on my books where the inoculated have not taken plague and the uninoculated have, where they have been both exposed to the same chance of infection. From the very first day it affords a certain amount of protection. Otherwise when these inoculations took place at the very height of the epidemic, from that day we would have had many more cases amongst the inoculated than we had. We had 50 cases amongst them, but there was a much greater number among the uninoculated. Then again we have the fact that in these cases which we inoculated during this time we have a much lower mortality, we have fewer cases and much lower mortality. I have five cases which had

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plague the day they were inoculated, and it is interesting to note that two of these died and three recovered. It is generally thought that if you inoculate a patient with plague you increase the severity of the disease. I thought it was not so, and I think that Dr. Hornabrook also came to the same conclusion. He watched the cases in the hospital.

1775. (*Dr. Ruffer.*)—I think you said that in some cases you found the temperature rose to 104 ?—Only in one case.

1776. In how many did you take the temperature ?—In 120 cases altogether. When I was at Hubli and was inoculating in the lines, I went round the evening after I had inoculated and took the temperatures, and I also went round the next morning. As a rule by the next day I found the temperature normal. If I went late in the evening they would tell me that they had bad fever, but I could not get more than 100 to 104.

1777. What was the average temperature you got in these 120 cases ?—As far as I remember it was about 101·8.

1778. Can you add notes to your evidence, because that is the point on which we have had very little evidence ?—I am not quite sure, but if I can I will. [On correcting the proof of her evidence the witness supplied the note required as follows :—]

Observations on after-effects of inoculation.

"In August 1898, while inoculating the families of the employés of the Southern Mahratta Railway in Hubli, I was able to take notes of the after-effects of inoculation in certain of the cases. The inoculations were generally done between 4 and 6 in the afternoon, and the patients visited the following morning about 8 A.M. and again the evening of the same day after 6 P.M. One hundred and five people were thus observed, who may be divided as follows :—

"Three infants 1—2 years of age, all twice inoculated with ⅕th the standard dose.

"Forty-nine children 2—12 years of age ; 46 twice inoculated with a dose rising from ¼ to ¾ the standard dose.

"Twenty young people 12—20, 17 twice inoculated with full doses.

"Thirty-three over 20—30, twice inoculated.

"These 105 persons thus give a total of 204 cases for observation, including second inoculations.

"*Fever.* In all cases where there was fever at all the temperature began to rise 3—6 hours after inoculation, and in three cases this was accompanied by vomiting.

"(1) One had a temperature of 103° at the first visit and 101° at the second. The following day the temperature was normal.

"(2) Fifteen had 101°—102° at the first visit, of whom 5 had 100°—101° at the second ; eight 99°—100° ; and two were normal.

"(3) Forty-eight had temperature 100°—101° at the first visit, of whom twenty-one had 99°—100° at the second, and two had 98°—99° and five were normal or sub-normal.

"(4) Sixty-nine had temperatures of 99°—100° at the first visit, thirty of these giving a history of having had somewhat higher fever during the night. Only five of these showed any elevation above 99° at the evening visit.

"(5) Fifty were normal to 99° and gave a history of some fever during the night.

"(6) The remainder had no fever. Among these were two of the infants under 2 years old.

"*Local re-action.* (*a*) In eighty-nine a 'good local re-action' is noted, meaning a swelling of the whole upper arm subsiding in 3—5 days.

"(*b*) Thirty-nine had 'fair re-action,' involving part of the upper arm only and subsiding in 2—4 days.

"(*c*) Seven had a 'very slight re-action,' in which only the area immediately surrounding the seat of injection was swollen, and the arm became normal in about two days.

"(*d*) Sixty-two had 'a severe re-action,' in which the swelling extended some distance below the elbow, the pain was fairly severe and the arm did not recover under 5—7 days.

"(*e*) In four cases the re-action was 'very severe,' the swelling extending to the wrist and the arm taking rather over a week to become normal.

"In ten the tongue was noted as 'very dirty :' in six as moderately furred,' and in the remainder as 'normal.

"About ⅓ of the adult patients complained of severe headache and about ½ of moderate headache. In the children this symptom was very slightly noticed.

"One man, a healthy European of about 33, received 10 c.c. of a prophylactic of half strength, (*i e.*, 5 c c. to the dose). He had a temperature of 102° the following morning, and the fever had not quite subsided until the third day. The arm was considerably swollen, but was completely normal at the end of 7 days.

"In 7 cases there was a slight glandular swelling in the left axilla which disappeared entirely as the arm became normal."

1779. How many abscesses did you get altogether ?—I have had ten.

1780. All at the same time ?—No. I had one about five weeks after I had been inoculating, and I had a crop of six just before I left. I was inoculating a good many people at the time and I may have relaxed precautions.

1781. Have you frequently found that the prophylactic fluid was evil smelling ?—Oh, no, not frequently. Out of thousands of bottles which I have used I do not suppose I have rejected twenty, and I have very likely rejected bottles upon which I was a little too severe and wrongly suspected.

1782. I suppose among the inoculated a certain number of people died from other causes clearly not plague ?—Yes ; but I have not been able to follow up these. I would have liked to have done it if I could, but I really could only investigate the plague cases.

1783. You have no figures showing the mortality from other causes in the inoculated ?—No ; but there are figures of the general mortality of the town during the epidemic.

1784. Did you ever make a bacteriological examination of the fluid which was sent to you ?—I did that frequently in M. Haffkine's laboratory. I investigated a good number of bottles.

1785. Did you make bacteriological examination of abscesses or microscopical examination ?—No, I did not ; I had not any opportunity of doing it ; they were just ordinary abscesses.

1786. (*The President.*)—You said that you did not care to wait more than ten days before making the second inoculation ?—Yes.

1787. For what reason ?—I think that it is as well to induce the second re-action as soon as possible ; of course we are theorising very much, but one feels one is educating the organism to resist. I have an idea that the sooner you repeat the lesson after the first the better. It is a method which one generally pursues in immunising animals. As soon as you have got over your re-action you repeat your dose as soon as possible.

1788. It is not because you are not quite sure whether the protection disappears after ten days ?—No, I think it would last longer than ten days ; we have the large numbers of those once inoculated to consider. It is not that, but I think the second inoculation does largely increase the resisting powers of the organism.

1789. You spoke of certain conditions which were considered by you as unfavourable for inoculation ; you said that you did not inoculate under certain conditions ?—Yes.

1790. Is age one of those ?—No, but infirmity is. If I see hale old persons I do not see why they should not be inoculated : I think they stand inoculation quite as well as children do, and children stand it very well indeed ; but supposing that a very infirm old person comes to me, I say, "I had better not inoculate you," because they may not stand the shock of the fever. In the same way I would not inoculate a marasmic child.

1791. Do you include Bright's disease amongst the diseases ?—Yes, but I might in the press of work inoculate a person who had Bright's disease, because one cannot always diagnose it from the mere aspect of the patient, and one does not make an examination.

1792. (*Prof. Wright.*)—You found most of the cases occurred in the first few days after inoculation, and you interpreted that as implying that some of your inoculated were already incubating plague ?—I said I had 50 ; I had 164 cases altogether which occurred on my register out of 12,555 ; that is the total on the Civil Hospital register and my register when I left Dharwar. I had 164 cases at that time with 64 deaths ; those are among the inoculated ; 50 of those occurred within seven days and 69 within ten days.

1793. That means a larger proportion in the first seven

Miss Corthorn.

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days?—Yes. It shows me that the protective power of inoculation is larger than mere figures would suggest by adding up your cases. If you do not eliminate those cases which occur within the first seven days you do not get such a large figure of protection.

1794. Do you know how it works out with regard to the second vaccination? In the case of the first vaccination which you were giving you told us that half the total number of cases of plague which occurred amongst the inoculated occurred within the first ten days. After the second vaccination is there a similar period of greatest liability?—No. I had a very small number to work from. I only had 30 cases in those twice inoculated, and three of those one might take out because they were cases which on each occasion were inoculated with very small doses.

1795. How many of those 30 plague cases occurred within the first ten days after second inoculation?—Seven contracted plague within ten days of second inoculation, three on the day of second inoculation and one the day after. Twenty-three contracted plague at varying periods after this interval.

1796. What do you consider the incubating period?—I have taken it as ten days.

(Witness withdrew.)

MR. WINTER M.R.C.S., L.R.C.P., called and examined.

Mr. Winter.

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1797. (*The President.*)—You are employed by the Plague Committee, I understand?—Yes, I have been doing medical work at Hubli for the last six months. I have come out specially.

1798. What are your medical qualifications?—M. R. C. S., L. R. C. P.

1799. (*Dr. Ruffer.*)—You have had special experience in inoculation work with Mr. Haffkine's method of inoculation; can you tell us how you standardised the dose which is to be used before you injected it?—It is marked on the bottles.

1800. Did you always inject the dose marked on the bottle?—According to the individual; if he is a strong man he may be given more, and if he is weak he will be given less, according to circumstances.

1801. Did you find that the dose marked on the bottle is usually right or did you alter it frequently?—When I first started, I invariably gave an extra c. c. above the standard dose marked on the bottle.

1802. And afterwards?—Afterwards we used to give the standard dose.

1803. You found no occasion to alter it in any way?—No.

1804. What precautions did you take against abscesses or contamination?—The arm of the patient is thoroughly cleaned and the needle is dipped in some disinfecting solution each time before it is injected into another patient.

1805. What is the average temperature after inoculation?—I have no figures of that.

1806. Have you ever noticed any evil effects after inoculation?—I have seen one case of urticaria which started the day after inoculation, and two abscesses.

1807. Have you ever had to reject fluid sent you for any reason?—Yes.

1808. Frequently?—Yes.

1809. How often?—I have the figures; I think we returned from over 300 full doses.

1810. (*Prof. Wright.*)—How many bottles full?—I cannot say; a bottleful varies with the strength of the dose. The standard dose is 2½ c. c., sometimes it is 10 c. c. In a bottle you may get only four or five doses.

1811. How many bottles did those 300 doses represent approximately?—I could not say.

1812. (*Dr. Ruffer.*)—Do you inoculate everybody who comes to you to be inoculated or do you reject certain people?—We reject a few.

1813. Whom do you reject?—I have rejected sickly infants and pregnant women, a few women who were evidently near the time to childbirth, and we also had some cases of people coming up with fever upon them; we have rejected all those.

1814. As a rule you inoculated most people who came to you?—Yes.

1815. Did you find any difference in the class of people among inoculated and uninoculated? Did you find the better class of Europeans and natives were inoculated and that the lower classes were not?—I do not think Europeans are inoculated as a rule; they do not come up to be inoculated very much. At the beginning certainly it is the better class of natives that comes up, and we try to get them as much as possible as an example to the others.

1816. What is the total number of inoculations which you have done personally?—I could not say; the books are all kept together.

1817. Then the figures which you have shown me to-day refer to the whole of Hubli?—Yes.

1818. Those are the official figures?—Yes.

1819. Could you total the number of the inoculated according to the figures?—Yes, I think the figures are arranged in weekly statistics and perhaps it would be better to give the gross total. The number of persons inoculated from the 12th May to the 29th November was 41,484. The total deaths amongst the inoculated were 366, and amongst the uninoculated 2,591.

1820. What is the number of cases which died of plague within 10 days of the inoculation?—Fifty deaths within 10 days among those once inoculated out of 67 attacks. The mortality from plague among twice inoculated persons within ten days of second inoculation is 12 out of 24 attacks.

1821. What is the total mortality amongst the people inoculated once and the people inoculated twice?—Among those twice inoculated 246, and among those once inoculated 121.

1822. You have worked out the percentages of that, I think?—The percentage of mortality among once inoculated persons is 71·59, and among those twice inoculated it is 78·35.

1823. Could you tell me the mortality from other causes amongst the inoculated and uninoculated during that period?—Among the inoculated 74, and amongst the uninoculated 646.

1824. You say that only 74 people inoculated died from other causes than plague, and 646 uninoculated people died from other causes in the same period; what percentage of deaths do these figures give in each case?—Among the inoculated ·1775 per cent. on the average census, and 1·5122 per cent. among the uninoculated.

(Witness withdrew.)

ASSISTANT SURGEON D. CARDOZ called and examined.

Assistant Surgeon D. Cardoz.

7th Dec. 1898.

1825. (*The President.*)—Will you kindly tell us your medical qualifications?—I am a graduate of the Grant Medical College.

1826. And your official position?—Assistant Civil Surgeon at Hubli.

1827. And you have been employed largely in plague duties?—Yes.

1828. (*Dr. Ruffer.*)—You have heard the evidence of Dr. Winter?—Yes.

1829. He has given us full statistics of the inoculations which have taken place at Hubli. I understand you personally have inoculated a large number of people?—Yes.

1830. Twenty thousand, I think?—Twenty-seven thousand inoculations.

1831. These statistics are included in the general statistics of Hubli?—Yes.

1832. Can you tell me what your rule was in standardising the prophylactic fluid for inoculation?—We had the fluid supplied of a particular standard from Bombay by M. Haffkine. The strength of the fluid varied. That

Assistant Surgeon D. Cardoz.

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supplied to Hubli varied from two and a half c.c. to ten c.c. per dose; and we gave two doses of this fluid for two inoculations and we considered the person fully inoculated when that was done. About a week elapsed before the second inoculation was done usually. But in some few cases the second inoculation was done a day or two after the first. Often the second inoculation was delayed to two or three weeks. The results so far as immunity goes I consider rather satisfactory.

1833. Did you take the temperature of the people you inoculated?—No. I had no opportunities for taking temperatures in all cases, nor even in many. But in the few that I did the temperature varied from 101 to about 103.

1834. Taken how long after inoculation?—Twenty-four hours.

1835. Did you notice any evil symptoms following the inoculation?—No dangerous symptoms particularly, beyond what would be due to fever.

1836. Did you ever have any abscesses?—Yes, I had about eight abscesses.

1837. Did you ever have to reject the fluid which was sent to you for any reason?—On two occasions.

1838. Why?—Because it smelt.

1839. You never saw a case of death following inoculation which you could clearly trace to inoculation?—No.

1840. I think you are physician to one of the hospitals?—Yes, at Hubli; I am the Civil Surgeon of Hubli.

1841. I think on several occasions you have had in your care people who had been inoculated and died of plague?—Plague cases were not treated in my hospital; they were usually sent to the General Plague Hospital, but I had sometimes to diagnose cases which came to the hospital.

1842. Did not you have any clinical experience of these cases?—I had a little because I was also in charge of the Plague Hospital for some time.

1843. Can you give us some information about the clinical course of the disease in cases which had been inoculated?—Usually the temperature was not high. Then there was not that exhaustion which one observed in typical cases among the uninoculated. Then the temperature went down rather sooner than in other cases, and on the whole the patient's attack appeared to be milder.

1844. Have you any statistics showing the number of deaths among the plague patients after inoculation?—Yes; I have some figures so far as my work is concerned.

1845. You have no general figures?—No.

1846. Then on the whole you consider the disease somewhat milder in inoculated people than in the uninoculated?—Yes.

1847. And on the whole you are favourably impressed with the value of inoculation?—I am.

(Witness withdrew.)

MR. R. HORNABROOK called and examined.

Mr. R. Hornabrook.

7th Dec. 1898.

1848. (*The President.*)—Will you state your medical qualifications?—M.B., B. S., (Adelaide, Australia), M.R.C.S., L.R.C.P., (London).

1849. I understand you are in charge of the Plague Hospital here?—Yes.

1850. Since what date have you been in charge?—Since the Plague Hospital was opened on the 28th August of this year.

1851. Have you admitted many cases of plague?—I have had about 740 admissions.

1852. What is the number of beds in this hospital?—We can hold 76.

1853. What was the greatest number of patients you had in one day?—76, we were full.

1854. What is the hospital staff?—Two hospital assistants, a compounder, a clerk, 3 English nurses, 2 native nurses, 8 ward boys, 2 ayahs, 2 day-sweepers, one night-sweeper, 2 washermen, and 2 coolies—about 31 on the staff altogether.

1855. Could you give us a description of the chief features of the cases which you have had?—They nearly all came delirious, and their tongue was furred and eyes injected, and most cases had a bubo generally in the lower extremity and a few of the cases were pneumonic.

1856. Any other type?—A very few of them had diarrhœa, and one case I had which I could not call choleraic plague because I believe it was cholera and plague.

1857. Can you give us the case mortality?—The mortality in the Dharwar Plague Hospital for plague cases is about 58 per cent.

1858. How does that compare with the general mortality?—It is about 20 per cent. better than the *plague* mortality generally recorded.

1859. On what day of the illness did you generally find that death occurred?—Over half occurred under forty-eight hours, and, as a rule, about a quarter within 24 hours, very soon after admission. The mortality is 57·88 per cent. and out of 736 admissions 235 deaths occurred within 48 hours and 124 within 24 hours.

1860. What was the treatment?—The patient on admission is, as a rule, given a dose of brandy followed in half an hour, in the case of adults, by 3 drams of sulphate of magnesia, and 2 grains of calomel. A child gets about 2 drams of sulphate of magnesia and no calomel at all. The object is to get the bowels open as soon as possible, because there is a marked improvement directly the bowels are opened; in fact the temperature falls down, and I always feel much safer.

1861. What is the highest temperature you have observed?—Never higher than 106, but very frequently 105.

1862. With regard to the treatment, have you treated any case with serum?—No, I have not; when I first came here I started injecting into the gland perchloride of mercury, but I had very bad results. I only had 4 cases and they were fatal.

1863. Do you know if there is much difficulty in inducing patients to enter the hospital?—We have absolutely no difficulty.

1864. Not at the commencement?—There was at first.

1865. Now there is none?—Absolutely none.

1866. They are very well satisfied with the conditions?—Yes; in fact we have a tremendous number of voluntary admissions—over 200.

1867. Do you allow the friends of patients to visit them?—Generally the contact comes down and is allowed to stay with the patient if he likes, but they do not very often come now, they generally leave them in our hands and go to the contact camp.

1868. (*Dr. Ruffer.*)—Have you had experience of plague with people who have been inoculated?—Yes.

1869. Have you noticed any difference in the clinical course of the disease in people inoculated and people uninoculated?—It is of a milder character in the inoculated. As a rule the case is less severe and the percentage of recoveries among those attacked after inoculation is much higher than among those who have not been inoculated. The percentage of attacks among the doubly inoculated is much less than among the once inoculated. Out of 16 doubly inoculated cases which I have admitted to the hospital, three only have died.

1870. The temperature does not go so high in the case of the inoculated?—No, it does not; the temperature is reduced and the patient is as a rule not delirious, but quite sensible. I have got the highest temperatures registered of all these cases.

1871. On the whole you think the course of the disease is milder?—On the whole I think it is. But you may have a very severe attack even after inoculation.

1872. What steps do you take when a patient leaves hospital, in the way of disinfection?—The clothes of the patient are disinfected, and the patient goes into the contact camp under observation.

1873. How do you disinfect the clothes?—By perchloride of mercury, one in a thousand.

1874. For how long?—They are supposed to remain in about 5 or 6 hours, and are then hung in the fresh air for 24 hours.

1875. And how is the patient disinfected?—By pouring over him some warm solution of perchloride of mercury.

1876. Of what strength?—It is supposed to be one in a thousand; I have not seen that strength cause any harm.

1877. (*Prof. Wright.*)—Have you ever seen a bubo in these cases, which have been inoculated, occur in the region in which they were inoculated?—Yes, I have seen it in a good many. You mean if I inoculated in the left arm I got bubo on the left axilla?

1878. Yes?—Yes, I have.

1879. How many days after inoculation?—That varies. In some of them it is soon after—may be the day after.

1880. Could you put in any case of that sort?—Yes, I have that written out here. I have 99 cases here of inoculated people admitted into hospital. Here is one man whom Dr. Corthorn inoculated on the 3rd October; he was attacked on the 3rd and admitted into the hospital on the 5th October and discharged on the 12th; he had a bubo in the left axilla, highest temperature 102·3.

1881. Was he inoculated in the left arm?—Yes. Dr. Corthorn always does so unless she is asked to inoculate in the right.

1882. How long after the inoculation was that?—The patient was attacked the same evening.

1883. Have you any other cases of that kind?—I have the whole list here.

1884. Will you hand it in?—Yes (handed in).* We had four cases in which persons went up and were inoculated when the plague had already manifested itself. None of these were fatal. Five cases in which the onset of plague occurred within 24 hours after inoculation, 7 cases in which death occurred within 24 hours after inoculation.

1885. (*Dr. Ruffer.*)—What did death occur from?—I am not quite certain. They were admitted as plague cases into the hospital.

1886. (*Prof. Wright.*)—Have you noticed that the people who got plague after inoculation are people who have had a very small rise of temperature; do you question them?—Oh, yes, every inoculated case is questioned.

1887. Are they in a condition to be questioned; can you find out when you have a case which has been inoculated whether they have re-acted well to the vaccination or not?—No, I could not.

1888. You have nothing bearing on that?—No, I have not.

1889. (*Mr. Hewett.*)—Are not the cases in this list which has been put in different from Captain Leumann's?—Yes.

1890. (*The President.*)—Under your observation?—Yes.

1891. Have you seen cases infected from pneumonic plague?—Yes, I have had four among my own staff.

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1892. What form?—They took the pneumonic form as a rule, and one man had a bubo as well, although he was a pneumonic case. He was what I call a washerman-sweeper, that is he did sweeper's work and also washed soiled clothes. He had it and also another of my sweepers. They would be very likely to do so from the sputum. I isolated the pneumonic cases as much as possible.

1893. Have you seen any cases of infection in bubonic cases from soiled linen?—Not in a bubo which has burst—certainly not.

1894. I mean clothes soiled with urine or fæces of dying people—are they disinfected?—Yes. The clothes are immediately taken away and put straight into perchloride of mercury.

1895. You do that in all cases?—Yes, but still the man who removed the clothes was liable to get infected.

1896. You never had a case of infection except in the pneumonic cases which you could trace?—I have had cases occur among contacts who have come to hospital. I think about 30 of them had plague, but all except 5 cases have arisen within 10 days after their coming into the hospital. I do not think they ever get their plague in hospital.

1897. When you say contacts in the hospital, you mean the people who come in with the patients?—Yes.

1898. Some of them developed plague afterwards?—Thirty of them developed plague.

1899. You do not know whether they got it in the hospital or in the house they came from?—No. There are five which I consider rather questionable, and I have put them against my hospital return because they got plague after 10 days. I consider about 8 to 10 days as the incubation period.

1900. Has plague occurred among any of the hospital attendants?—I have had four bubonic and two pneumonic cases among my hospital staff.

1901. Were they infections from pneumonic cases?—I should say those bubonic cases were not from the pneumonic cases, because those were in the early days before I had pneumonic cases. The pneumonic cases were probably infected from pneumonic plague patients, as there were a number of these cases in the hospital at the time: two of the ward boys were attendants on pneumonic cases at the time they were attacked.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Collector's House, Dharwar.

EIGHTH DAY.

Thursday, December 8th, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.

PROF. A. E. WRIGHT, M.D.

MR. A. CUMINE.

DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

MR. E. L. CAPPEL, I.C.S., recalled and further examined.

Mr. Cappel.

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1902. (*The President.*)—I think you have something to add to the statement you made yesterday?—There was one point which was only touched upon yesterday which the Commission desired information upon, and of which I had not the figures then, and that is as to the importance of the segregation and the contact camps. I can give you some figures about that now, as to the numbers of the persons segregated in each camp and the number of contacts, in order to show the value of the segregation camps. The so-called contacts who have been segregated in Dharwar in the contact camps numbered from first to last 927. Out of these persons 50 were sent from the camps to hospitals sick with plague. Six persons died in the camps and 34 persons were sent to hospital with the sick as attendants upon them, those 34 persons being themselves inmates of the contact camps. So that the facts stand as follows. There were 927 contacts and 50 were sent sick to hospital, 34 were sent with these sick as attendants upon them, and six died in camp. Out of 34 attendants sent to hospital, these persons being themselves contacts, 27 took plague in the hospital within ten days. In other words, their infection is not attributable to the hospital; they were already infected when they were taken to the contact camp.

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* See Appendix No. XVI in this volume. The Appendix shows, in addition to the 99 cases referred to in the evidence, records of 40 cases not treated in the hospital, and of 69 cases collected by witness after the date of his examination.

Mr. Cappel.

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1903. Is that certain, do you think?—I think it is a fair inference, because the incubation period is certainly more than ten days, at any rate in many cases, and therefore if we credit all the persons who took plague within ten days to the original infection, and credit all the others to the hospital, we certainly are not being too fair to the hospital.

1904. We have had evidence that the period of incubation was sometimes shorter than ten days?—Yes; of course shorter ones are included. That is the working theory we have gone upon. In Hubli towards the end of the epidemic we had to keep contacts in the contact camp 18 days, because we found that they developed plague up to that time.

1905. (*Mr. Hewett.*)—From another contact?—No. I do not think they took it from each other.

1906. Could they have not done so?—It is not likely, because in the contact camps they are under the immediate medical supervision of the officer in charge, and our medical examination is made morning and evening. They are brought into the contact camp as persons likely to be infected. I want to show how many of these contacts did get plague and how important their segregation is.

1907. (*Dr. Ruffer.*)—There are 927 contacts, and of these only six died, I understand?—Six died in the camp, *i.e.*, when the daily morning or evening inspection was made, these persons were found dead.

1908. There were 50 sick persons?—Fifty sick persons were taken from the contact camps to hospital.

1909. How many died?—I have not the figures.

1910. There were 34 attendants on the sick?—Yes, they being themselves members of the 927; and out of those 27 got plague within ten days of arrival.

1911. (*Prof. Wright.*)—How long after they had been placed in the contact camp?—I have not that figure; it is not really so very important because the ten days is an under-statement. When a contact is brought to a contact camp, he and his clothing and everything with him are dipped and bathed and disinfected and dried and exposed to the sun. He is not admitted to the camp to one of the huts until he has been thoroughly disinfected. This being so, and each contact being under constant medical observation, one contact can hardly give plague to another.

1912. (*Mr. Hewett.*)—May he not have been in the incubation stage of plague at the time?—Yes, that is why they are removed.

1913. How can one be sure that there is no infection between one member of a camp who gets plague and another?—Plague is not infectious in the early stages as far as our experience goes.

1914. (*Dr. Ruffer.*)—Does it not strike you that the medical supervision cannot be very accurate if you find six people dead in the morning, who were not suspected of having plague the evening before?—I do not think so; I could not throw stones at the medical staff.

1915. I am not throwing stones at them, but I want information?—This plague is a strange thing. I will not trench upon the medical details, but know of course that the septicæmic form can be fatal in a few hours after attack. I do not assert that everything was absolutely complete, but the arrangements were in charge of careful medical assistants.

1916. (*Mr. Cumine.*)—Supposing two men arrive in a camp, one who has no plague and the other who has, and who developes it in five days. Contact A gets plague in five days; contact B catches plague from contact A on the fifth day.—I think that cannot be so.

1917. In that case contact B might not develope plague until the twelfth day after arrival in camp, and yet his incubation period might be only seven days. Is not that so?—I think that cannot be so.

1918. (*The President.*)—Assuming that to be so, how does that affect your point?—The only difference is that you may add the 27 to the people infected in the hospital or infected in the camps.

1919. (*Mr. Hewett.*)—It was stated in Bombay that it was a frequent occurrence that a contact developed plague within four or five days, and that infection would pass on to another contact, and so on. We were given definite details as to the number of days after they were brought to camp.—I can get you these details, I expect; I can get you the dates.

1920. The question is important as regards the deduction you draw that the period of incubation extends beyond ten days?—I did not draw that deduction from any of these figures but from our general experience in Hubli, and it was not a deduction which I drew myself. We began by detaining contacts for ten days, but after the medical officers had experience, towards the end of the operations, when I was making my round, I found Dr. Leumann was segregating people in the contact camps for 18 days.

1921. I thought you had put it forward?—No. Taking the figures as I have given them, you get a plague incidence of 83 on 927 contacts.

1922. Were these contacts uninoculated?—I have no figures about that, but I should think nearly all.

1923. (*Prof. Wright.*)—Supposing we take your figure, that there is an incidence of 9 per cent. among contacts, what is the incidence among non-segregated in the town?—It was 9·4 at Dharwar.

1924. That would not prove that your contacts were not more likely to get plague than any one else; it would prove you effected nothing whatever, neither good nor harm, by your contact camps?—I only give you the figures; a question was put about these camps, and I wished to explain the number of cases which occurred there.

1925. (*Dr. Ruffer.*)—It makes a mortality of 8 per cent.

1926. (*Mr. Cumine.*)—Of the 50 removed to hospital, could you tell us regarding each case how many days after his arrival in the contact camps he developed the plague?—I have not that figure here, but I can get it. [The information subsequently supplied was as follows:—Among the persons sent to the Plague Hospital as sick from the contact camp at Dharwar a nominal roll which has been prepared shows that—

		Days in camp.
5	persons were sent after passing . .	1
11	„ „ „ „ „ . . .	2
8	„ „ „ „ „ . . .	3
6	„ „ „ „ „ . . .	4
5	„ „ „ „ „ . . .	5
1	„ „ „ „ „ . . .	6
1	„ „ „ „ „ . . .	7
4	„ „ „ „ „ . . .	8
1	„ „ „ „ „ . . .	9
7	„ „ „ „ „ . . .	10
1	„ „ „ „ „ . . .	25
50		

Among those who went to hospital as attendants r patients, it appears from their nominal rolls that—

		Days after a sion into hospital a tendants.
4	persons were attacked by plague . .	1
6	„ „ „ „ „ . .	2
1	„ „ „ „ „ . .	3
4	„ „ „ „ „ . .	4
2	„ „ „ „ „ . .	5
1	„ „ „ „ „ . .	6
1	„ „ „ „ „ . .	8
1	„ „ „ „ „ . .	9
2	„ „ „ „ „ . .	10
1	„ „ „ „ „ . .	13
1	„ „ „ „ „ . .	14
1	„ „ „ „ „ . .	16
1	„ „ „ „ „ . .	22
1	„ „ „ „ „ . .	42
27]		

1927. (*The President.*)—Have you any more points to mention?—This may be interesting to the Commission. We had of course quarantine camps, or, as we call them, observation camps, here, in which passengers either by rail or by road, generally by rail, coming from infected places were detained unless they had special passes. They were detained here for various periods, but generally for 10 days. We had during 12 months 4,225 persons so detained, amongst whom there were four attacks.

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1928. Why were they detained?—They were detained in the quarantine camps because they came from infected places.

1929. Not because they had exhibited any symptoms of illness?—No; they were detained because they had no exemption passes; that was one of our protective measure under the orders of Government.

1930. (*Prof. Wright.*)—Was the plague in Dharwar and Hubli during that time?—There was plague at Dharwar only at the end of the time. The quarantine camps were closed in the beginning of November 1898 as being useless, owing to the invasion of the district by plague. I may add that four attacks, of course, were no indication of the value of the system. The value of the quarantine system was not small because there were only four attacks among 4,000 people segregated, because the existence of these preventive measures prevented the sick from travelling. We had a further institution by way of a health camp which I believe the Commission has seen.

1931. Would the sick travel much?—They stopped travelling at once as soon as the detention system was started. All over India you will find in the quarantine or detention camps very few cases.

1932. What object has a sick man in travelling?—He is travelling away from an infected place, where plague measures are being taken, in order to avoid these plague measures. It was to stop that way of spreading the disease that the Government instituted quarantine camps at the main stations.

1933. (*The President.*)—Your quarantine camp was in operation between what dates?—The quarantine camp started on 16th November 1897 and wound up at the commencement of November this year. Then the further institution which we had was the health camp beyond the Fort. The health camp was opened on 19th July 1898, that is to say, it came actually into operation then. It was built long before that. Up to date 919 persons have occupied it, and out of these four died in camp and eight were sent to the Plague Hospital.

1934. Did the people volunteer to enter the health camp?—No, not at all. The camp had accommodation for 600 people at a time, and in fact more if necessary; but we had the greatest difficulty in getting the people to go into it. When we vacated a house or an area, we gave the people the option to go to these quarters, but they always preferred to make their own arrangements, and we allowed them to do so as long as they left the infected quarter and did not go to another quarter of the town. They were allowed to camp in the open country, but were not allowed to go to villages.

1935. These were the people who had been in infected houses?—Not from infected houses, but from infected areas. There were only 12 cases among these 919 people, and the inference I draw is that we vacated these areas in time to save them from infection.

1936. Have you any evidence regarding the duration of the protection afforded by inoculation?—As regards the duration of the protection afforded by inoculation, I may state the following facts. Inoculation was begun in Hubli on the 11th May, and from 11th May to 17th June 1898—I merely give that date as a convenient one as to which I have figures—2,323 people were inoculated. In other words, all these people have now been inoculated for six months; and some of them for over six months. Of course the inference is a continuing one as we proceed. The point that attracted my attention is that in the case of these 2,323 people, if the effect of protection had exhausted itself in them, we might expect a recrudescence of plague at Hubli.

1937. (*Prof. Wright.*)—I understand that six months is not quite up?—It is for those who were done on the 11th May. I only wish to say that that shows at any rate it is good for six months.

1938. Or for a less period than six months?—It is good up to six months. The six months are complete, and in some cases it must be a good deal over six months.

1939. What is the present rate of plague mortality?—Two or three sporadic cases a week, and they seem to come from reinfection.

1940. Then there is no evidence, is there, that the germs of plague are at present to be found in the town? You cannot assure us that the germs are still there?—I am not able to say that the original plague infection remains in the city; but I should think it extremely likely that it remained. My experience does not justify me in concluding that the disinfecting operations have destroyed every microbe of plague in the city.

1941. (*The President.*)—What is the population of Hubli at present?—The present population is about 42,000; the normal population is over 50,000.

1942. You mean to say that 2,300 people out of 42,000 have been inoculated a sufficient time ago to afford some indication of the period during which inoculation affords some protection?—That number was inoculated before the 17th June, and to that extent some evidence is afforded of the duration of the protection; because I think that you must assume that the infection is still there. Whether it is the original infection lingering in the town or not does not matter very much. The town of Hubli lies in the centre of a deeply-infected district, and there is constant intercourse between this large town and the surrounding infected villages. There can be no doubt whatever that, but for the protection by inoculation of the whole population, including these two thousand, we should have fresh cases—we should have an epidemic.

1943. (*Prof. Wright.*)—With regard to the question of policy, when you get your first plague cases in a town, what measures do you take?—The measures depend upon the season of the year. In Hubli we were led to our inoculation policy because the only practicable alternative—that of wholesale evacuation—was impossible owing to the monsoon season. Having taken up inoculation and having got promising results, we pressed it, with the results of which I gave evidence yesterday.

1944. I think perhaps you misunderstood me. When the very first cases, which you called imported cases, are brought into the town, what line of policy do you adopt?—When an imported case occurs, that is to say, when we can distinctly trace the importation and we know that infection was not incurred on the spot, we remove the patient to hospital, and the inmates of the house to the contact camp, and we disinfect the house, and therewith the operation stops.

1945. Then where you have an imported case you merely take precautions against the spread from that spot: you disinfect that spot?—In an indigenous case we treat a locality as infected. We assume the indigenous case has arisen from the infection of the locality, such infection having been caused by an imported case. We remove the patient to hospital and the inhabitants of the house to the contact camp, and we also disinfect the house in which the case occurred immediately. At the same time, we draw an imaginary line around the area which we assume to have been infected, and we turn out or evacuate the whole of the houses in that area, and remove the inhabitants to the health camps.

1946. Supposing A to be an imported case, and supposing B to have visited A, why do you not infer that B may have been infected by personal contact with A?—Against that I have to show the remarkable immunity in the plague hospital of persons who are in personal contact with infected persons. Therefore we draw the inference that B, if he gets plague, has been infected by the locality occ update by A, and that that locality has been infected by the imported case, *i.e.*, by A himself.

1947. Do you think you may infer from the fact that infection does not take place in the Plague Hospital where you have disinfectants that infection does not take place in the houses of the people in the town?—I think infection is not from the person, but from the house. Therefore, if B gets plague, I assume the house in which A is, is itself infected and is the indigenous centre of infection.

1948. Then when you find an indigenous case of plague, you take the very severe method of evacuating the whole region?—Yes. It is a drastic measure.

1949. Why not take the simpler measure; why not assume that your indigenous plague case was infected from a particular case which is discoverable? For in that case you would only have to disinfect the two houses. Why do you assume your indigenous case must have infected himself from the soil? Why do you assume that the whole locality is infected?—That is the working theory on which the whole of our operations has been based.

1950. We want to know what the working theory is based upon?—It is based upon observation of the course taken by the disease in given localities and upon the immunity of people attending on patients.

1951. Do you not think that this particular inference is vitiated by the fact that disinfectants are used in hospitals?—Those disinfectants prevent the infection of the soil of the locality; but they do not interfere with personal infection.

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1952. (*Dr. Ruffer.*)—Do they disinfect the soil in the hospitals?—The floor and the lower part of walls are done twice a day with corrosive sublimate.

1953. How many attendants have you got here in the hospital?—When I speak of the immunity of the attendants on the sick, I mean people who actually accompany the sick to the hospital, the friends and relatives. We get hardly any case among them. There have been about 900 of these in the Dharwar Hospital and about 40 paid servants. Among these 900 there were only 26 cases of plague, and the probability is that not more than 5 or 6 of these contracted the disease in hospital. Of the hospital servants 6 contracted plague, of which 4 cases were of the pneumonic form which is known to be infectious. May I mention with regard to the working hypothesis of local infection that that is not my own, but was formulated and declared by Major Anderson, I.M.S., Deputy Sanitary Commissioner. My observations have convinced me that that working hypothesis is a sound one, the evidence of personal infection appearing to me to be exceedingly slight.

1954. (*Prof Wright.*)—Will you give us some more detail with regard to the policy you adopt when you find an indigenous case?—We make as large a sweep as we consider practicable. We consider the whole of that immediate locality infected as soon as an indigenous case occurs. In the case of a village we take out the whole village, and in the case of towns we do so where possible. We did not do that at Hubli at first. We worked on the principle that by turning out a large area we might stop the course of the epidemic, but time after time we found we were beaten. We stayed the course of the epidemic, but when a fresh case occurred, it was always not far from the boundary of our last evacuations, and we failed, although we went so far as to burn down one whole street at a cost to the Municipality of Rs. 5,000. That has further convinced me of the soundness of Major Anderson's policy, that when you have an indigenous case in a town, you must treat the whole place as infected.

1955. When do you let the people back?—After an indefinite period depending on circumstances, as was stated yesterday. But in the case of the towns we have always given the people the option of inoculation. If they will accept inoculation, we let them back at once after ten days have elapsed.

1956. (*The President.*)—I presume the houses have been disinfected?—Yes, if a plague case has occurred in a house. It is always vacated and disinfected in these cases. If no plague case has occurred, that process is not gone through necessarily, provided the people are inoculated. The value of inoculation appears to me to lie in its enabling us to keep town populations together. If you have to evacuate bodily, and—as already remarked in my opinion for evacuation to be of any use it must be total and complete and not partial—if you have to evacuate completely a large mercantile town such as Hubli, you do a damage to mercantile and business interests which is almost as bad as the plague itself. You dislocate the commerce of the country; not only of that town but of all places with which it is in business communication. The policy of inoculation and of allowing the people to remain on the infected areas on condition of inoculation enables us to keep the mercantile community together, and allow trade to maintain its course. In Hubli trade was not seriously interfered with at any time, and in Dharwar the course of business has never been interrupted. In Hubli, owing to weather conditions, the town was never evacuated on any large scale. In Dharwar about one-third of the people went out immediately on the outbreak of plague. But these people who went out were of the agricultural class owning land round about, and their families and dependants. The ten thousand people who remained and who were enabled to remain by inoculation alone were the Government employés, the large mass of railway employés, and the business part of the community. There was no interruption to railway business, Government business, or commercial business in Dharwar. That state of things would have been impossible without inoculation, and if inoculation had not been carried out or if inoculation had failed, the consequences would have been very serious both in Hubli and Dharwar.

1957. Can you give us any example in which inoculation has proved as effective as evacuation?—I have given you the facts about Hubli and Dharwar. We were enabled to keep the nucleus together, whereas in Sholapur they had to evacuate the whole town. We should have to have done that in Hubli and Dharwar, without inoculation.

1958. (*Prof. Wright.*)—Did you let the people go back under the same conditions to the houses in the villages?—No; we found from experience that inoculation provides no policy of protection in rural areas. It has a great advantage, which I have mentioned, in towns, but in rural areas all you can do is to immunise the individual and the community remains unprotected, because it is impossible to secure inoculation of whole villages or of all the villages. Therefore in a village of one thousand people the inoculation of five hundred might be a very successful operation, but it would do little good, because the remaining five hundred would still carry on the epidemic among themselves, and from that it would spread to other villages. In fact I can see no plague policy in inoculation in rural areas. Not only that, but the more recent experience has shown us that inoculation is the cause of trouble and inconvenience in dealing with rural areas. Up to now I have encouraged the inoculation of villagers as far as possible, because one naturally wishes to give the people every help which one can. The people have been encouraged and allowed to go to the inoculation centres of Hubli and Dharwar and Gadag to be inoculated, and that is still going on. But I went further than that; in Hubli we arranged to send out medical officers to villages round about so as to form a sort of inoculated belt round Hubli. That was done by Dr. Cardoz and Dr. Winter, and I think Dr. Leumann visited some villages also. We have found that these more or less partial inoculations gave rise to a great deal of trouble. If you give the same privileges to the people in the villages as you do in the towns, then the inoculated persons remaining in the house form a harbourage for the uninoculated who are turned out. As soon as the inoculating officer's back is turned, the people from the huts come back to live and stay with the inoculated people who remain.

1959. Would not that occur in towns also?—No, because in towns you have a complete supervision system. Here, for instance, we have a Chief Superintendent and we have a number of Superintendents under him, and a still larger number of supervisors under them; and every house is brought under supervision every day by trustworthy agency. And all new arrivals and all departures are returned in daily returns, and also there is a weekly census. All that is impossible in villages.

1960. In towns you can turn out uninoculated people?—In towns you can catch them; in villages you cannot control them.

1961. (*The President.*)—Do you suppose they come back at night to sleep in their houses?—It may be done to a certain extent in towns, but it is not done to a very large extent. It would mean coming in from a considerable distance to sleep; it would get known in the town and would probably be reported, or it would become known to the supervisor of that ward and he would call attention to it. The people would be unwilling to do that on a large scale, because, if it was discovered by the Chief Superintendent, he would probably say to the inoculated residents, "you have been abusing my arrangements and taking advantage of them, and now you will have to evacuate your house while it is disinfected thoroughly, because you have been letting suspicious people in." The villagers are very anxious to be inoculated and my remarks about the drawbacks of inoculation in villages are rather pertinent to that, because these inoculation measures have been on such a large scale in Hubli and Dharwar, and have gone on for so long, that the people round and about have been thoroughly convinced of the advantage of inoculation. From one village a long way south of Hubli I had an offer from a native banker to produce five hundred people for inoculation and pay all the expenses of the English Commissioned inoculating officer and his staff. I had another application from the basket-weavers of a village 22 miles south of Hubli, who offered to come in in a body to Hubli if we promised not to segregate them or put them in health camps, a promise which I gave them. There is another village called Annigerry which has frequently applied to me by telegraph and otherwise for the assistance of inoculators; and, that village being a large one, we have treated it as a town and given it the benefit of inoculation. But for the reasons stated, I am strongly of opinion that in rural areas the immunization of the individual is useless and does more harm than good.

1962. (*Mr. Hewett.*)—What evidence do you take that any man has been inoculated; do you accept the statement of any practitioner?—In this district inoculation has been carried on solely and entirely by commissioned officers or by subordinate medical officers working under their immediate superintendence.

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1963. Do you see objection to taking any medical practitioner's certificate?—I do; I think that officers not in the employ of Government or officers not holding a medical commission should not inoculate, because the object of the people in a very large proportion of cases, and the object of almost all the people at the beginning of the operations before they became convinced by bitter experience of the advantages of the process, is not to obtain an inoculation but to obtain the certificate which carries with it certain immunities and privileges. In order that there should be complete confidence in these certificates, I think it extremely desirable that only commissioned medical officers should have the granting of them, and carry out the operations. Further from the questions which this Commission put yesterday to some of the medical officers, it will have been gathered that there are certain risks, however slight, attending the actual operations which may be disastrous to the public confidence if they were multiplied by any carelessness on the part of the operators. In the case of Government servants we have a complete guarantee of responsibility in that respect. There is also a certain risk of people obtaining certificates by personation; and for all these reasons I am of opinion that only Government officers should be entrusted with the operation. For a very long time also the supply of lymph will not be more than sufficient for the use of Government officers, and I think they should be supplied before private practitioners are entrusted with the work. There is also the objection to the private practitioners doing this work, that the inoculation process is at present, and I suppose will continue for a long time to be, more or less experimental, and in order to judge of its value you must have returns and figures, such returns and figures, for instance, as I gave yesterday to the Commission. The only guarantee for these returns and figures is that they are supplied by a responsible Government officer. If the inoculations are carried out by private practitioners, we cannot enforce the getting of these returns at all; nor have we any guarantee that they are properly kept.

1964. (*The President.*)—How do you maintain the identification of a certificate-holder. Might he not pass on his certificate to some one else?—Not easily. Because the register is kept very carefully, with the full details of age and sex, and if there is any doubt, local persons can always be consulted. My experience is that, where the register is kept under the rules laid down, and where it is properly done, there is little room for personation; but personation may come in afterwards by the transfer of certificates.

1965. You do not take any identification mark of the individual?—We do not. It is stated in one of the Government rules and in Mr. Haffkine's instructions that a thumb mark should be taken, and on our certificate form we have a place for that thumb mark, and the instructions are that that thumb mark should be taken, but in actual practice we have found it exceedingly difficult to do it, and we do not think it is even a necessary precaution. I take it that that rule originated in Bombay, where you have an enormous population, and where it is exceedingly difficult to trace individuals and identify them, and in such cases it becomes very necessary. But in up-country places the identification of any individual person is comparatively easy, and when you are inoculating a whole population, as we have been doing, at a very rapid rate and with a small staff, that is to say, when one inoculator does from 700 to 800 cases in a day, as has been done on occasions here, it is impossible for him to attend to that thumb mark impression. It is a thing which cannot be done quickly. You must have proper ink and the person must be held and otherwise induced to put his thumb down neatly and carefully, or it would get blurred. We have found that in the hurry of the work it was impossible, and we did not find it was necessary because we have never found any difficulty in identifying holders of certificates; the only difficulties have been the cases of transference of certificates for the purpose of getting passes to which the people were not properly entitled, and we have had one or two prosecutions to stop that.

1966. (*Dr. Ruffer.*)—Do they sell certificates?—I think it has been done to some extent but not to any large extent, because the holder of a certificate values it for himself and will not part with it.

1967. You do not think there is trade in certificates as in Mecca, where there is a regular trade and regular agency for pilgrim passes?—I think there is nothing of that sort.

1968. (*Mr. Hewett.*)—Can you give us the smallest number of people in Hubli and Dharwar during the epidemic?—The smallest population in one week in Hubli was in the week ending September 2nd—the population was 38,210.

1969. All in the town?—That is the popula ctually in the town.

1970. Of these how many were inoculated?—Thirty-seven thousand one hundred and ninety-six were inoculated.

1971. That is practically the whole population?—Yes, there was a balance left of 1,014 uninoculated.

1972. What was the lowest population in Dharwar?—Nine thousand.

1973. But a great many more than this number were inoculated?—Yes, 18,000.

1974. At the time the population of Dharwar went down to 9,000 in the town, where was the balance of the 18,000 inoculated? I want to ascertain where the surplus of the inoculated persons was.—Some of these persons had left Dharwar and had gone to other places under protection of the inoculation certificates, and a large number of them were outside the town in camp. When the epidemic broke out here, I issued a number of notifications through the newspaper press and otherwise and advised everybody to follow my own and the other officers' example and be inoculated. I promised that, if they were inoculated, they might live in the town. But I also advised them most strongly to receive the inoculation and also leave the infected area.

1975. A certain number left the infected area and passed out of your observation altogether?—Yes.

1976. Were the people who had left the infected area included for the purpose of ascertaining the number of deaths among the inoculated persons?—No. When the people leave the infected area, whether inoculated or not, they are to a large extent lost to us for the purpose of plague incidence statistics. But the number of people who have actually gone away to other places is comparatively small; I have made enquiries about that. A great bulk of them are camped outside in their gardens and in huts which they have put up, and the mortality among them is known to a certain extent; we are likely to hear of it although the inspection of these huts is not so thorough as it might be and as it would be if we had a larger staff. In these latter days these cases are voluntarily brought into the hospitals. We have about 12,000 people in Dharwar, of whom 10,000 are inoculated. This is the last return I have seen.

1977. There are a large number of persons who have been inoculated, who are not in the town, or in the camp at present?—Yes. They are all outside in camps.

1978. What camps?—Their own camps, private camps.

1979. In what direction?—In every direction, all round Dharwar.

1980. Are they under close supervision?—No, they are not.

1981. Can deaths occur in these camps without your knowing of them?—Yes; we exercise a certain supervision, but we have not a staff sufficient to exercise complete supervision, on scattered country houses as you may call them dotted all over the surrounding country.

1982. Then is it not possible that the statement of mortality among the inoculated persons is incomplete?—The statement of mortality refers only to the cases we actually get.

1983. Is it incomplete?—We must assume there are plague cases among the inoculated persons outside.

1984. But you cannot tell the exact number of inoculated persons from whom these plague cases might be taken?—No, we cannot tell the exact number. Dr. Miss Corthorn has made very careful enquiry and has pursued her enquiry in these huts to a very large extent.

1985. But there is a margin of error?—Yes. The error does not affect the comparative incidence of plague upon the inoculated and the uninoculated, however, in any material degree.

1986. You do not think it is a large one?—No, because in Hubli there was no margin of error at all.

1987. Because the population there was confined and under your observation?—Yes. Our plague incidence in Dharwar was called 6 per cent. and in Hubli 8 per cent. I do not claim a very much better incidence in Dharwar than in Hubli. I do not think it is better to that extent, although I think it is better. The point which you have raised is perfectly correct, and I do not wish to alter that at all. There is a margin of error undoubtedly, but for comparative purposes the error is not so important because it cuts both ways. It cuts with the uninoculated as well as with the inoculated. The uninoculated and the inoculated are both out in camp in large numbers and are both

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escaping observation to that extent; and therefore when you make a comparison between the plague incidence of inoculated and uninoculated, the error is compensatory.

1988. I understood you to give statistics only of the uninoculated actually in the town?—Yes, all those we can catch. If we find plague cases among the inoculated persons who are outside the town, if they are brought in the hospital by any means, whether voluntarily or because we find them, we put them down on our record against our statistics of inoculated persons. The same applies to the uninoculated.

1989. In the week ending September 2nd there were about 1,000 people uninoculated in Hubli town?—Yes.

1990. And apparently in Hubli you had the whole of the uninoculated under observation?—Yes.

1991. In Dharwar you had the whole of the uninoculated under observation, but not the whole of the inoculated?—A large number of uninoculated were also outside in Dharwar. Both classes have camped outside in large numbers and are not under close observation. What I mean to say is that a large number of persons are outside in camp here in Dharwar, some inoculated and some uninoculated. When we get a case of plague in the inoculated persons or uninoculated persons, when it is brought in, it is put down on the statistical record at once. Any error cuts both ways as regards the comparison of incidence of plague between the inoculated and the uninoculated; the error is compensatory; it is as much on one side as on the other. A large number of uninoculated are out in camp and a large number of inoculated are out in camp.

1992. (*The President.*)—Are the inoculated people less likely to go to camp than the uninoculated?—Not necessarily; and many inoculations have been performed on persons already in camp outside the towns. I have strongly advised them all to go out. I have already pointed out that a large number of distant villagers came here to be inoculated; *à fortiori*, the people who are just outside are willing to accept protection. That is why you have much larger number of persons inoculated than persons actually resident in the town.

1993. (*Mr. Cumine.*)—In Dharwar throughout the epidemic, since the people began to go out, have the majority of the uninoculated as a rule been outside in huts or inside the town?—The uninoculated on our register are all in the town.

1994. Would you be able to say whether the majority of the Dharwar people who are uninoculated are outside in the fields or inside in the town?—The majority of the uninoculated persons are outside undoubtedly; because there are 20,000 of the inhabitants outside and only 10,000 in.

1995. By far the great majority of the uninoculated inhabitants of Dharwar are out in huts?—Yes.

1996. Is not there a tendency when the men out in the huts get plague, for those men to wish to go into their houses and die there?—We have not found any cases of people being carried in. A great many came into the hospital for treatment.

1997. Not going into their houses merely to die?—No, we have not found that.

1998. There are some figures I should like to have to show at what pace inoculation went on in the different wards and at what pace the attacks went on in the different wards. Perhaps you can have them made up for me?—We can get that done. [NOTE.—Witness subsequently informed the Commission that he found he was not able to get the figures asked for.]

1999. When there were only about one thousand uninoculated people living in Hubli, the attacks amongst them were at the rate of about 657 per thousand?—Yes.

2000. Were these 657 all among those remaining in Hubli, or had some been brought in from the people in the huts?—There were no people in the huts; and Hubli was the last place that anybody would have dreamt of going into. The endeavour was to get out of the cage, not in.

2001. I thought you might have had people going about inspecting huts and bringing in any sick people they found in them?—There was no camp outside Hubli at that time. It was pouring with rain; life in camp there is impossible during the monsoon. The only camp was the health camp and, of course, the contact and hospital camps. All residents in those were under strict observation.

(Witness withdrew.)

CAPTAIN BROWNRIGG, I.S.C., called and examined.

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2002. You have had experience of plague at Hubli?—Yes.

2003. How long have you been here?—Only two months; I began here at the end of September.

2004. Before you came to Hubli, you were at Ahmednagar?—Yes.

2005. (*Dr. Ruffer.*)—How long were you at Ahmednagar?—I did three months' plague duty there.

2006. Were you in charge?—I was Cantonment Magistrate.

2007. I think you had a general supervision of all plague measures which were taken?—Yes, in the Cantonment.

2008. Can you tell the Commission what measures you took in that place?—The bazar was evacuated in 24 hours after about the second or third indigenous case.

2009. Had you much difficulty in evacuating the place?—None whatever; the people turned out almost without a murmur.

2010. You turned them out?—There were no sheds erected actually when they got out. A few of the people had run up erections of their own; but the sheds were not put up till three or four days afterwards. They lived under blankets.

2011. How many people did you turn out?—There was a population of about 3,000, and 1,000 of these bolted.

2012. After what length of time did they bolt?—It was really on the night after orders were issued.

2013. So that practically one man out of three disappeared?—Yes; every precaution was taken, but they got away; they left their houses and went off without taking anything with them.

2014. Do you think they bolted on account of fear of the plague or of fear of the measures?—Fear of the measures.

2015. Among these 2,000 people who remained in camp you had a certain mortality?—Yes.

2016. Do you know the exact number of deaths?—No; approximately 30 while I was there.

2017. Some may have died afterwards?—Yes.

2018. But some died soon after the evacuation of the town?—Yes; up to three weeks after the place was evacuated there were about one or two deaths a day in the camp.

2019. So that among the 1,000 people who bolted it is a correct inference that there may have been a certain number of cases of plague?—Yes.

2020. When once people had settled down in their new places, did you find much difficulty in keeping them there?—No, we had a census taken at once.

2021. They were never allowed to go back to their houses?—They were allowed in the day time, while their houses were being unroofed, disinfected and whitewashed; the whole of the bazar was disinfected and whitewashed.

2022. And they came back at night?—They slept in the camp at night.

2023. Did you have a contact hospital at Ahmednagar?—Yes.

2024. Do you know what the mortality in that hospital was?—No.

2025. You have been on duty in Hubli since September and you have seen a good deal of work which has been done in that time. Did you find much difficulty in inoculating people?—Not since I have been there; they are only too anxious to be inoculated.

2026. Did you see anything of the segregation of people in Hubli?—Yes.

2027. Did you find that it was difficult to segregate people?—No. There were very few complaints.

2028. That was during the last two months?—Yes.

2029. You have no experience of the first part of the epidemic— No.

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2030. So that you cannot tell us whether there was any difficulty then?—No.

2031. Did you notice any evil effects after inoculation?—No.

(Witness withdrew.)

Mr. J. McNeill, I.C.S., called and examined.

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2032. (*The President.*)—You are now Collector in this district?—Acting Collector.

2033. I understand you have been here just over a fortnight, and that you come here from Surat. How long were you there?—I was in Surat from November 1897 up to the beginning of May 1898; I was Plague Ward Superintendent in Surat. I was acting Collector at Surat from May until a few days ago.

2034. Then you have had a large opportunity of seeing plague in Surat?—I have seen a great deal in Surat City.

2035. (*Mr. Cumine.*)—You went there in November but the plague had begun in August?—The plague was at about its worst when I came there.

2036. So that it is not within your personal knowledge how it originated in Surat?—No.

2037. Is it within your personal knowledge how it originated in the ward which you had charge of?—No; my ward was badly infected before I was put in charge.

2038. How did you hear of cases in your ward; did you search from house to house?—At the beginning of September cases were detected by searching from house to house; but under the plague rules an order was issued that people must report sickness or death immediately to the nearest plague authority. In the majority of cases the sickness was reported, but in a very large number of other cases it was not reported directly. There was a staff of supervisors and others employed under me, and they went about and made enquiries, and sometimes we got private information that there was a sick person in a house, and we went to it, and sent the patient to the hospital and segregated the contacts. In the majority of cases we got the information from the people themselves.

2039. From your experience did the plague seem to be carried by human beings, or rats, or how, from one house to another?—As far as my experience goes, I think it was carried by human beings; that seems to explain almost every case I came across.

2040. Did you find any instances in which it was clearly traceable that B, who was infected to-day, had been three or four days before to see an infected person?—We found cases where there was a very close connection between a person who had got plague, say, to-day, and people who had been to the houses of people who had developed plague.

2041. Did you find rats die before someone in the house became infected? I have heard when one made inquiries in plague cases that rats had died, and one sometimes heard that a house was empty and that the people had run away on account of having dead rats in their houses.

2042. When you opened the closed houses of people who had run away, did you ever find dead rats in them?—About the month of April, when we were beginning to disinfect all houses which had not been opened up, we found dead rats—in houses which had been closed for months; and, as far as I know, they were there before there was any plague in the immediate neighbourhood, or before the people had come in contact with the plague; the people having run away at the beginning of the outbreak, we never had any reason to believe that any person connected with the house had been infected with the plague, but we simply found dead rats there in a house which had been closed up for months.

2043. Did the plague seem to go from one house to the adjoining house or to the opposite house, or did it seem to move forward in a line, or did it go in an entirely erratic manner?—When I took charge of the ward first, I found three or four streets all occupied by people of the same caste, and in these streets there were perhaps five or six or more houses in which cases had occurred. But when these streets were evacuated, in the rest of the ward generally I did not find these cases went from house to house necessarily, but cases occurred here and there all over my ward. I did not find that they followed one another in any regular line.

2044. The streets in which you found adjoining houses infected were streets inhabited by people of the same caste?—Poor people of the same caste.

2045. Who would be likely to visit one another?—Who were probably more or less inter-related.

2046. What castes suffered most in your ward?—I believe the weavers probably.

2047. What caste would they be?—Chhipas; besides that, there were a few Golas in my ward. They suffered most really in the Golawad which was in the ward next to my own, and a good many of them died; a fairly large number of Sunars and a fairly large number of Ganchis were attacked. Speaking from memory, these castes were the worst.

2048. Are these castes dirty castes, living in dark, ill-ventilated houses?—I do not know that houses of the weavers are darker than other houses. The houses of the poor people are not kept very clean and they have very few comforts of any kind. I should not say that the houses of the weavers were darker than the ordinary run of houses. The weavers' houses were generally dirty and the Ganchis' houses nearly always filthy. The Sunars' houses were comparatively clean.

2049. You became Collector in May?—At the end of May.

2050. The epidemic had ceased in the previous March?—I think in April, but the epidemic had ceased as an epidemic in March.

2051. Surat has not been infected again?—No; the village of Umra has been infected. There was a severe attack there at the end of July and August, just about the time of the heaviest fall of rain. That village was two miles from Surat.

2052. Did you keep the people in to prevent them going to Surat?—We kept about 500 entirely in the village except two, and they were let out under special conditions; one of them died and the other did not. Mr. C. V. Vernon, I.C.S., was in immediate charge of the plague operations at Umra.

2053. Have you had any imported cases in Surat?—We had three or four imported cases. We had one apparently indigenous case which we could not explain. It was the case of a girl living in the Orphanage attached to the Irish Presbyterian Mission. I think there were about 80 children there altogether, and one of the children developed symptoms which were pronounced to be plague symptoms by the Civil Surgeon and by a native lady doctor there. We shut them all up and disinfected the premises, and no other cases of plague occurred in the Orphanage. That was a local case.

2054. Do you know how plague came into Umra?—We had reason to believe that some of the people had attended a funeral at an infected village across the river about five or six miles away. We could never find out the exact truth.

2055. Was there anything noticeable about rats in Umra?—Nothing.

2056. Was there any incursion of rats from Umra into Surat?—None.

2057. What means had you in Surat of keeping a watch upon the mortality in the villages?—The village officers sent a weekly report to the Mamlatdar, and these reports were very carefully scrutinised. Besides sending the weekly report, if there was anything special about the mortality in the village, anything which the village officer thought noticeable, he had orders to make a special report to the Mamlatdar. If two or three persons died in a house, the officer would have been punished if he had simply given the ordinary mortality return showing three deaths.

2058. Is there anything else which occurs to you to say of your own accord?—No, I do not think so.

2059. (*Mr. Hewett.*)—When the Mamlatdar got the report from the village officer, I suppose it was his duty to bring it to the notice of the Collector or Assistant Collector?—He would ordinarily go to the village himself, before he gave any notice, to make enquiries. If he could not go himself, he sent his Head Karkun.

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2060. Provided the Mamlatdar is satisfied by his inspection, the matter need not go to the Collector?—No. The Mamlatdar would take the responsibility.

2061. (*Dr. Ruffer.*)—You had no inoculations in Surat? —Practically none.

2062. After the epidemic stopped about the end of March, you had one indigenous and a few imported cases only; do you know why the epidemic has not started again; Surat, I take it, is still in communication with infected districts?—We had a very strict system of surveillance of people coming by railway, and that was practically the only way they could come from the infected places. Persons were either detained on arriving at railway stations or were placed under surveillance for ten days if they came from infected places.

2063. Is that still in force?—It was when I left Surat.

2064. You had that system the whole summer?—Yes.

2065. Do you think the system acted efficiently, or do you think there was a certain amount of contraband?—I think on the whole I should have heard if people had evaded surveillance. I had a great many complaints about the system, but I did not hear it was inefficient.

2066. You have had no new indigenous cases except that one case which you have mentioned?—No.

2067. (*Mr. Hewett.*)—Can you tell me what is the medical staff you have under your orders in Dharwar at present?—In Dharwar town itself on plague duty alone there is Dr. Sirur, a private practitioner paid by the Dharwar Municipality; then we have Dr. Hornabrook, Dr. Winter, and Dr. Foy, and Dr. Miss Corthorn. Major Anderson, of the Indian Medical Service, is practically not on medical duty. He is doing administrative work. We have also an Assistant Surgeon, Dr. Cardoz, at Hubli.

2068. How many Hospital Assistants have you altogether? —Seventeen, including Hospital Assistants in charge of grant-in-aid dispensaries. Some Hospital Assistants in charge of dispensaries do miscellaneous plague duty in addition to ordinary duties. A few assist in carrying out preventive measures in uninfected towns in talukas quite free from plague. Six Hospital Assistants have charge of stationary dispensaries, and one is in charge of a travelling dispensary. Besides these seventeen Hospital Assistants, there are three on ordinary duty at the Civil Hospital and Lunatic Asylum, Dharwar.

2069. Is there any Assistant Surgeon besides Dr. Cardoz? —One more; they are both at Hubli.

2070. How many nurses?—Three European lady nurses at Dharwar and one lady nurse at Gadag.

2071. Four European nurses?—Yes. The following list shows medical officers and subordinates specially entertained on plague duty. The ordinary medical staff of the district consists of one Civil Surgeon, one Assistant Surgeon (Dr. Cardoz), and ten Hospital Assistants:—

Statement showing the names and localities of employment of Medical Officers, Assistant Surgeons, and Hospital Assistants employed on Plague Duty in the Dharwar District, during December 1898.

Name of officer.	Locality in which employed to do duty.
Medical Officers.	
Dr. E. Hill	Dharwar. Was transferred to administrative works in the Dharwar taluka at the end of November.
Dr. R. W. Hornabrook	Dharwar.
Dr. Miss Alice M. Corthorn	Gadag.
Dr. E. S. Winter	Hubli.
Dr. F. Foy	Gadag.
Miss D. B. Hyland, Lady Nurse	Dharwar.
Miss M. Murphy, ditto	Do.
Mrs. M. E. Pearse, ditto	Gadag.
Miss E. Riley, ditto	Dharwar.
Municipal Health Officer.	
Dr. Sircar, L. M. & S.	Dharwar.
Assistant Surgeons.	
Mr. J. V. Mascarenhas	Hubli.
Hospital Assistants.	
Mr. W. J. Cindekar	Dharwar.
„ Gundo Yadneshwar	Do.
„ Jethalal Chimanlal	Do.
„ V. Gopal Katay	Do.
„ Govind Rangnath	Hubli.
„ Appaji Abaji	Do.
„ Satyaprasad Bhagavanlal	Do.
„ Govind Rangnath.	Do.
„ Appaji Abaji.	Do.
„ Bhavanilal Harishankar Trivedi	Gadag.

2072. (*Dr. Ruffer.*)—What is, roughly, the population of this district?—The population in 1891 was 1,051,314 and is now probably 1,100,000.

2073. Have you any disinfecting stoves or apparatus?—We have them at Hubli. The Municipal towns keep a supply of disinfectants in stock, and have simple apparatus for disinfecting houses or clothing.

(Witness withdrew.)

MR. A. S. A. WESTROPP, I.C.S., called and examined.

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2074. (*The President.*)—I think you are an Assistant Collector in this District?—Yes.

2075. You have had general supervision of the plague work?—Yes.

2076. (*Mr. Cumine.*)—At the end of last year and the beginning of this year you were at Belgaum, I think?—Yes.

2077. At Belgaum there are two towns, one the city and one called the cantonment?—Yes.

2078. The plague appeared in the cantonment first?—Yes.

2079. But you were not employed in the cantonment, I think?—No.

2080. Is it within your personal knowledge how plague originated there?—No.

2081. In November plague appeared in the city of Belgaum?—Rather before November.

2082. Were you given a ward in the city of Belgaum?—Yes.

2083. Is it within your knowledge or have you any ground for believing in what way the city became infected; do you know which was the first case?—No.

2084. Was your ward infected when you took charge of it?—I discovered plague cases the first day I went there.

2085. But there was none registered up to that time?—No.

2086. What plague cases did you discover the first day?—I discovered two cases amongst the Bhangis (sweepers).

2087. Have you any reason to believe that they became infected in any particular way?—I was inclined to think that they were infected from the cantonment direct.

2088. Were the people of that class in the cantonment infected?—They were.

2089. And there would be communication between the city Bhangis and the cantonment Bhangis?—I presume so.

2090. When you found those two cases, what did you do?—The Bhangi quarter was at once evacuated. They lived in a separate building, an old caravanserai, and it could be easily and effectively vacated.

2091. In this place to which you took the Bhangis were any people attacked?—I think there was one fresh case.

2092. Do you remember how many days after they had gone in?—No, I could not say.

2093. How long did you keep them out in this place?—Over ten days.

2094. In the meantime did you disinfect their houses?—Thoroughly.

2095. Then you let them back again?—Yes.

2096. Then did more cases occur?—Yes.

2097. What did you do?—I cleared them out again and they remained out for an indefinite period.

2098. In the meantime did any fresh cases occur among the other people in your ward?—Yes.

2099. Amongst whom?—I cannot remember among which particular class.

2100. Could you trace any communication between the different people infected?—No; the infection probably came from other wards in the town.

2101. Could you trace how it was brought, whether by the people having gone to see sick people?—No, I could not say.

2102. Did you observe any mortality amongst rats?—No. Curiously enough, it was not brought to my notice. I made inquiries about that.

2103. Inoculation was tried, I think?—Yes.

2104. But you have not got any figures?—No.

2105. As regards the villages of the Dharwar district you have had a good deal of experience in the plague-stricken villages there?—Yes.

2106. Have any facts come under your observation which would enable one to see whether the infection was generally carried by human agency or by other agencies?—By various agencies; by persons and their personal effects and rats.

2107. What are the facts which you have observed to show that it is carried by personal effects?—There was a case which at the time satisfied me that plague was brought from one village to another by a man bringing the effects of a dead man from the infected village to an uninfected village.

2108. But to get those effects he had to go to the dead man's house?—Yes.

2109. Why should you assume that the plague was brought in in the effects rather than in the man?—It was because some other members of his family died first.

2110. Did he himself get plague?—He subsequently got plague.

2111. How many days after his return with the effects?—Three days after the member of his family got plague; I do not remember how long it was before that that he visited the infected village; it was probably four days before that.

2112. Was this member you mention the first plague case in his village?—Yes.

2113. But you do not know how long it was after his return with the effects that his relation developed plague?—Certainly not more than four days.

2114. What is the name of that village?—From Bhandwar it was imported to Shirguppi.

2115. Have you any other case where it has apparently been carried by clothes?—No.

2116. By rats?—I recently came across one village where all the people were out living in huts. I asked them why they had gone, and they said on a certain day, four days before that, at 9 o'clock in the morning two dead rats had been found, on the same day a little later about 12 o'clock another dead rat was found in the next door house, and still later in the day two more rats were found in the house next to that; in consequence of that the people in those three houses left them the same day and the other people in the village left their houses also.

2117. Did anybody get plague?—No, no cases were reported.

2118. Had any person come to visit from a plague-infected village?—No; but there was a very highly infected village close by within half a mile. And the first houses where the dead rats were discovered were the nearest along the road from that village.

2119. Had the rats been seen crossing from one village to another?—The people were unable to tell me that.

2120. Was the highly infected village evacuated?—It was in process of evacuation.

2121. Have you any other case of rats to mention?—Yes, I came across another village with regard to which my information is not so exact, but I heard the villagers had evacuated the village on account of dead rats being discovered in their houses. In that village also no case occurred.

2122. Have you anything you wish to say in addition to what you have said?—I do not think so.

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2123. (*Mr. Hewett.*)—When the people evacuated a village as a rule they go into huts which they make themselves?—Yes.

2124. And there is no medical man on the spot who can tell whether a case is one of plague or not?—No, not usually.

2125. You have to rely upon the diagnosis of the village officer?—Yes.

2126. And if one of the inmates of the segregation camp gets plague, I suppose he is not necessarily removed from that camp?—Nothing beyond the common sense of the people would lead them to it.

2127. I mean if a man gets plague in the segregation camp in the neighbourhood of a village, he is only removed from that camp if the other persons in the camp insist upon it?—Of course the villages are inspected as much as possible by the Executive Officers.

2128. Do you insist upon their removal?—I should if it came to my notice.

2129. But do you think it is unusual for plague cases to occur in the segregation camp?—I should think that now it is getting unusual.

2130. I suppose it also happens that when the village is segregated the persons who are suffering from plague at the time go in a separate set of huts?—Yes.

2131. Do people who have not got plague ever go and settle down among those huts?—No.

2132. These particular huts are only for plague patients, and there is no risk of healthy persons being infected in that way?—No.

2133. Do the attendants of people who have got plague go and settle down in those huts?—Yes.

2134. And these are treated as if they had the infection themselves.?—Yes.

2135. They are not allowed to mix with other people?—No.

2136. What security is there when you have a village evacuated in that way that the persons who are in attendance upon the plague patients do not mix with the persons in other segregration camps where there is no plague?—The Executive Officers try to prevent that as much as possible.

2137. It is impossible, is it not, unless the Executive Officer is always there himself?—That is so.

2138. You cannot be certain that communication of that kind does not occur?—No.

2139. It would be impossible to make any arrangements which would make it certain that no such communication should take place, would it not, unless you had a European officer over every camp?—That is so.

2140. How long do you keep your people in segregation?—As long as possible.

2141. I mean up to what limit would you keep the people out whom you are putting out now from a plague-infected village?—They are told they will have to remain in the camp for a month after the last case has occurred.

2142. During the period they are in the segregation camp they are allowed to visit their houses in the village?—Not usually. It would be at the discretion of the Plague Officer to allow them to return to fetch anything they urgently required.

2143. Are not they required to do certain things to their houses?—Yes; but they have to do that without going into them.

2144. They do not actually enter the houses, but they have to take off the tiles from the houses in which they before evacuation lived?—Yes.

2145. It is not possible I suppose to disinfect these houses in the villages; there is not sufficient staff to do that?—It would take such a long time that it would be practically impossible. There is a party employed in one of my talukas consisting of a European constable with two Muccadams but they take a very long time.

2146. I understand it is because you cannot disinfect that you insist upon their staying out so long?—Yes.

2147. That is a part of your arrangement?—Yes.

2148. With regard to Belgaum the inoculations there were done under Major Bannermann?—Yes, he introduced them.

2149. (*Prof. Wright.*)—Do you medically inspect the

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people before you let them back to the village?—That is a question which has not arisen yet in this district.

2150. (*Dr. Ruffer.*)—You fix at a month the period which has to elapse before you allow people to go back to the village. I should like to know what facts guide you as to that?—There is another condition, that they must have ventilated their houses for one full month.

2151. But why 1 month, why not 15 days or 3 months?—That is a question for a medical officer to answer.

2152. I understand you are in charge of this district?—I take my orders on the point from the Collector, who is advised by medical officers.

2153. In these hospital camps where patients are placed you have simply the diagnosis of the Headman?—That is so.

2154. Is it not a fact that in some at any rate of these hospitals other patients besides plague patients are admitted?—It is possible; there are a series of huts.

2155. But in some of these huts there are two people?—Yes.

2156. So that it is quite possible that a non-infected person might be placed in a hut with an infected person?—They would all be of one family.

2157. In order to exclude that possibility you have only the diagnosis of the Headman of the village?—Usually so; there is a touring Hospital Assistant for each taluka and he would be able to control anything like that.

2158. Can you tell me how many villages you have to inspect?—About 400, I suppose, in my charge.

2159. Scattered over how many miles of country?—About 1,000 square miles.

2160. Whom have you to help you for that work?—There are two Staff Corps officers and an English doctor.

2161. Is that all?—There is a complete Revenue establishment of natives of course, assisted by a certain plague establishment, which has been appointed by the Collector.

2162. What is that plague establishment?—There is a special native Plague Officer to each taluka, and there are three such special native officers.

2163. Does that give the whole number of the staff?—Yes.

2164. Will you kindly hand that document in?—Yes. It is as follows:—

List of the Subordinate Officers put on Special Plague duty—Dharwar District.

Taluka.	Special Plague Head Karkuns.	Circle Inspectors.	Abkari Inspectors.
Dharwar	1 (A)	3	1
Hubli	1	2	...
Gadag	1	3	1
Navalgund	1	5 (B)	1
Ron	1	2	1
Bankapur	1	2	1
Kalghatgi	...	2	1
Ranebennur			
Karajgi	...	9	1
Hangalkod			
TOTAL	6	28	7

Taluka.	Vaccinators.	School-Masters.	REMARKS.
Dharwar	3	In infected villages.	(A) also the ordinary Head Karkun has been put on special plague duty.
Hubli	1	Do.	
Gadag	2	Do.	(B) This includes two Circle Inspectors withdrawn from the Second Assistant Collector's charge.
Navalgund	3 (C)	Do.	
Ron	2 (C)	Do.	(C) This includes one vaccinator withdrawn from ditto.
Bankapur	2	Do.	
Kalghatgi	1	Do.	*N.B.*—The District Inspector, Land Revenue and Agriculture, has been deputed to do duty under Mr. Lushington in the Ron and Navalgund Talukas.
Ranebennur	5		
Karajgi			
Hangalkod			
TOTAL	19		

2165. (*The President.*)—How many doctors are there in this district?—I could not give that information.

2166. (*Mr. Cumine.*)—Have you any figures of the attacks and mortality in the villages?—I have.

2167. Could you give some?—Will you give me a lead as to what points you wish me to speak upon.

2168. You might give us three or four of your severest instances, *i.e.*, instances where plague was the deadliest. I want to see what effect evacuation had and I should like to know the number of cases before evacuation and the number afterwards?—In certain villages owing to the difficulties we had evacuation was practically impossible and consequently the plague pretty well had a free hand.

2169. (*Mr. Hewett.*)—Could not you put a statement in?—I can prepare one.* One would be attached to my ordinary plague report which the Government would in due course call for. There is one village in which there was a proportion of 47 per cent. of cases. In that village evacuation was practically not adopted on account of the rain, it being in the middle of black soil.

2170. What was the population?—2,203. That is the highest percentage in any village I have had to deal with.

2171. Within what period?—Within three months; the death rate in that village was 35 per cent.

2172. That is a rather long epidemic, three months?—I think if a village is left to itself three months would complete the epidemic. This is a somewhat exceptional case. There was another village in which the attacks amount to 32 per cent. of the population. In these cases when I say evacuation was not resorted to, I mean that segregation was resorted to, but broke down under pressure in the sudden rush of cases.

2173. (*Prof. Wright.*)—Did you have to go back upon your regulation when the rush of cases occurred?—The first cases we segregated; and, as far as possible, segregation was carried out; but heavy showers of rain would come down and render the huts uninhabitable. Then the people would go back into the village.

2174. (*Mr. Hewett.*)—What is the population of this second village?—2,548. In that village also evacuation only took place as a precaution after the epidemic had practically died out.

2175. How long did it last?—Two months and a half.

2176. Practically the weather prevented you from taking measures and the plague consequently ran riot?—Yes.

2177. Have you any others to give us?—There is another village in which 30 per cent. of the population were attacked. These three were, I believe, the severest village epidemics in the district.

2178. (*Prof. Wright.*)—Have you any village in which there was a small mortality?—No.

2179. Suppose there were twelve cases in a village, would you necessarily hear of it?—Yes.

2180. How do you get this information that two or three more deaths than normal, or two or three deaths from plague, have occurred in a distant village? How is this brought to your attention?—The death-rate would show it.

2181. Suppose there were only half a dozen cases more than the previous year?—We rely upon the village officers' reports in such matters.

2182. You were going to make out a case for segregation, showing that it was beneficial. First you show us the case in which the plague has been allowed to go on by itself, and there has been great mortality. I ask you if there are any other villages where the plague was left to itself and where there has been small mortality?—No. There are villages in which evacuation was adopted.

2183. (*Dr. Ruffer.*)—No, a non-evacuated village.

2184. (*The President.*)—From what have you selected these examples?—These are examples of villages in which evacuation has taken place too late.

2185. They are villages in which no effective measures were adopted?—Yes.

2186. (*Mr. Cumine.*)—There are a number of villages where nothing could be done in the way of total evacuation, and you have selected these particular ones because the mortality in them was particularly high?—Yes.

2187. (*Mr. Hewett.*)—Can you tell me some in which the mortality was particularly low?—No, I cannot do that, such cases do not occur.

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* The witness submitted later three statements A, B, and C, printed at the end of his evidence.

2188. What is the lowest you have got in which there were no measures adopted?—30 per cent.

2189. Is that the lowest you have got there?*—These are four of the villages which were attacked during the heavy rain and these are the percentages.

2190. Do these four villages include all the villages in which you know the plague took place and in which no measures were taken?—That is so. No effective measures.

2191. And the lowest percentage of attacks in these four villages was 30 per cent.?—That is so.

2192. (*Dr. Ruffer.*) Can you give us an account of the epidemic of plague at Byahatti?—Byahatti is a village about 8 miles from Hubli town in the Dharwar District. The first case of plague was reported by the village officers on the 23rd August 1898. The infection was imported from Hubli where plague was raging at the time. The death-rate up to the 23rd had been normal, but after the first case, plague spread with intense rapidity as it has done in all villages similarly situated in this District. This may be due to climatic conditions; but I would also be inclined to attribute it to the stay-at-home habits of the people in the rains (the village being then but a muddy swamp) and the absence of ventilation in the over-crowded houses. These conditions must at least be favourable to the spread of the disease. It is believed that the pneumonic form of plague was prevalent which the above conditions would more or less account for. On the 23rd August the first case was recorded. An official at once visited the village and segregated the sick and contacts as well as circumstances permitted. He also disinfected the houses in which cases had occurred. The sudden rush of cases, the absence of accommodation for contacts and sick, and the difficulty of road communications, however, caused the disease to get completely out of hand. The total evacuation of the village by the healthy, which was the next measure contemplated, could not be secured till the end of October for the following reasons. Byahatti was one of the first villages attacked in this part of the district. The inhabitants did not understand the great advantages of evacuation, were apathetic, and in a passive manner opposed the measure. The roads were practically impossible during August, September and the early part of October. Hutting material which had to be fetched by the people from the Government depôts was thus not available at the village. The hutting material was, moreover, not such as would keep out rain, and the country round about was not suited for camping out till towards the end of October. For the same reasons the partial evacuation and the segregation attempted during the rainy months of August, September and October was rendered inefficient and consequently unsuccessful. By the 1st November the village was cleared of its healthy who were camped in huts of their own construction in the fields. The sick, of which there were then a large number (possibly 150), were left in the village each with one attendant. The staff was however insufficient to keep the contacts apart and many cases occurred amongst attendants. However, November showed a marked decrease, and the epidemic disappeared early in December. Since the 23rd December there have been no fresh cases and the death rate is normal. The villagers are still living out in huts and the village has been disinfected and ventilated. I regret that I am unable to give any further details. I consider this is not a test case for either segregation or evacuation, but rather a case showing the virulence of the disease when efficient segregation and evacuation is rendered impossible. The following figures relate to the village:—

Byahatti: Population in 1891—3,589.

Deaths in	Year 1897.	Year 1898.	
May	14	15	On 23rd August first declared case of plague.
June	39 (17 cholera).	15	
July	15	9	
August . . .	15	13 up to 23rd August and 18 from 23rd to 31st August. (Plague 15).	

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Deaths in	Plague.	Other causes.	
September 1898 . .	265	10	
October 1898 . .	384	5	
November 1898 . .	116	1	
December for week ending . . 7th	7	...	
Do. 15th	11	...	
Do. 23rd	2	4	
Do. 24th to 29th	...	2	

The total number of plague cases is 1,111, and the total number of deaths due to plague is 80). There have been no fresh cases or deaths of plague since 23rd December 1898.

2193. You say that if there was only a very small mortality from plague in a village in which nothing had been done, you would surely find it out?—There may be a few imported cases which one could not find out.

2194. (*The President.*)—If you have any other villages in which measures were adopted to contrast with the villages in which no effective measures could be adopted, will you please let us have them?—The village of Unkal was evacuated in one month. The death-rate before and during evacuation was 8·8 and ·05 per cent. after evacuation. The plague has since ceased. Population 3,915.

2195. How long after the plague was found out was the village evacuated?—It was completely evacuated within about a month.

2196. Within a month after the discovery of the first case?—Yes, the first indigenous case. There is a village which was evacuated in about three weeks in which 5 per cent. of cases occurred before evacuation, 8 per cent. afterwards and none since.

2197. (*Mr. Cumine.*)—Within what time afterwards?—Within three weeks.

2198. And nothing after three weeks?—Nothing after three weeks up to the present date. A small village which was evacuated within two days when fine weather came had 1·6 of deaths before evacuation and none since. A village evacuated in six days had 1·4 per cent. before evacuation; 4 per cent. after evacuation. A large village of 4,075 inhabitants of which one-quarter was cleared out promptly had 6 per cent. of cases before evacuation and none since; the whole village has since been evacuated as a precautionary measure.

2199. (*Mr. Cumine.*)—This quarter was cleared out how many days after the discovery of plague?—Within a fortnight after discovery of plague.

2200. And the attack rate before evacuation was how much?—I could not give you that figure.

2201. (*Dr. Ruffer.*)—With regard to the village of Aminbhavi which we saw yesterday you told us that if a few cases of imported plague came into the village, you would at once or in a very short time notice it?—I say so only because it is my experience that if a few imported cases occurred it would afterwards burst out.

2202. When were you first informed of the presence of plague in the village we saw yesterday?—There was a formal report of plague received on the 24th about. Dr. Hill had visited the village before that date on the strength of a rumour. Dr. Hill went out to the village, discovered a couple of cases of plague, and said there was cholera in the village.

2203. There have been 68 deaths in that village since 1st November and the average mortality for that month in the previous year was 8. Therefore you had an increase of something like 8 times the normal mortality before it was noticed, if the figures are correct?—Up to the 20th there were 20 deaths in that village. In the month of October there had been 18 deaths and in September 18 deaths. So up to the 20th 20 deaths having occurred was not any reason for violent suspicion to be aroused.

2204. Even taking 20 deaths, the normal mortality in that village was 8?—In the villages now there is a good deal of ague and the death rate in the months of September and October has been very high this year from ague.

2205. I think it is important that we should get these figures right?—Fifty-three cases occurred from the 21st of November

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* See statements at the end of the witness' evidence.

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to the 6th of December, but the Headman showed you the register which would contain the list of up to date cases.

2206. I asked him what was the mortality up to the 24th November when it was first noticed. He told us that there were 68 deaths from the 1st November to the 24th, and that the village was evacuated on December 1st?—He must have misunderstood you, because that is not the case.

2207. How many deaths were there from the 1st of November to the 24th?—Twenty deaths up to the 20th. Then there were 3 deaths on the 21st; 5 on the 22nd; 3 on the 23rd; 4 on the 24th—that is 35 up to the 24th.

2208. The mortality was double that of the previous year, and more than four times that of the year before?—Measures were taken when the 3 cases occurred on the 21st.

2209. But the village was not evacuated till December 1st?—A big village like that is not easily evacuated. Orders for evacuation were given, but there were difficulties in the way. In order to see the use of evacuation we must see when these measures are applied. In this case they were applied more than a month after the mortality began to rise. I should say a good many people had left the village by the 25th and 26th.

2210. When measures were taken you had nearly four times the mortality of the year before?—Yes, that is so, I suppose.

2211. (*Prof. Wright.*)—Have you any well considered scheme for testing the efficacy of evacuation?—The total of these two figures as compared with total percentage, when the village is left to itself, would show the advantage of evacuation.

2212. You mean it would if it were compared with the maximum mortality, but you ought obviously to compare it with the minimum mortality?—Then compare it with the minimum.

2213. We want to be sure that you really do know what would be the minimum mortality which would occur if plague were left to itself. We have seen in this case a very large mortality did occur without its coming to your notice?—You mean immediately; it ultimately comes to our notice.

2214. Supposing you had an increase of 20 per cent. on the ordinary deaths, would that have come to your notice? Has there been another village where there was an increase of 20 per cent.?—I do not know; one knew there was plague there on the 20th.

2215. You commenced evacuation measures on the 20th?—Yes; soon afterwards the people were ordered to leave the village. Then of course one has to give them a certain period, and in that particular village there was some difficulty in getting materials.

2216. (*The President.*)—When did the evacuation commence?—It probably commenced on the 24th November.

2217. And when was it completed?—It was thoroughly completed on the 1st December.

2218. What are you doing with those houses which have been evacuated?—The people have been told that they must ventilate them by making holes in the roofs and that they will not be allowed to return until they have done so. If they do not do so, it will be done by hired labour.

2219. Have you any time limit before you employ hired labour?—We see how they take to it themselves.

2220. What in practice do you consider a reasonable period?—About a week.

2221. Have they already commenced to do anything which you have ordered?—I do not know at present—I do not think they have.

2222. (*Mr. Cumine.*)—I suppose with such an enormous number of villages infected you find it difficult to attend to each village promptly?—That is so. I may tell you that I have 119 villages infected with a population of 150,000, so that the dates and figures as regards each village are difficult to get without notice.

2223. I think you said that in this village which the Commission visited yesterday, the mortality had been about 20 during the months of September and October?—Yes.

2224. It being 20 up to the 20th would not strike one as being very high?—No.

2225. When 3 deaths and 5 deaths and 4 deaths occurred each day, your attention was attracted to the matter?—Yes.

2226. These deaths did not occur without attracting your attention?—No.

(Witness withdrew.)

Three statements A, B and C, afterwards submitted by Mr. Westropp, are as follows:—

STATEMENT A.

Showing the villages in the District of Dharwar which, owing to unfavourable conditions, were not totally evacuated by their inhabitants until late in the course of the epidemic.

Name of Taluka.	Serial Number.	Name of Village.	Population, 1891 Census.	Date of first case of plague.	Date of last case of plague.	DATE OF EVACUATION.		TOTAL NUMBER OF PLAGUE DEATHS.		
						Commenced.	Completed.	Before evacuation.	While evacuation was in progress.	Subsequent to evacuation.
Hubli . .	1	Byahatti	3,689	23-8-98	19-12-98	26-10-98	1-11-98	669	39	92
	2	Fugalhalli	2,203	19-8-98	23-11-98	30-9-98	6-10-98	682	69	59
	3	Kusugal	2,548	18-8-98	7-11-98	27-10-98	2-11-98	759	3	1
	4	Bhandiwad	1,306	21-8-98	24-10-98	2-11-98	8-11-98	485	0	0

STATEMENT B.

Showing certain villages in the District of Dharwar vacated during the course of the epidemic.—

Name of Taluka.	Serial Number.	Name of Village.	Population, 1891 Census.	Date of first case of plague.	Date of last case of plague.	DATE OF EVACUATION.		TOTAL NUMBER OF PLAGUE DEATHS.		
						Commenced.	Completed.	Before evacuation.	While evacuation was in progress.	Subsequent to evacuation.
Hubli . .	1	Bujruk Alikatti . . .	2,362	4-9-98	18-11-98	28-9-98	4-10-98	65	36	167
	2	Sulla	2,082	6-9-98	4-12-98	12-10-98	18-10-98	133	17	119
	3	Unkal	3,915	11-9-98	19-11-98	25-10-98	31-10-98	312	35	2
	4	Kiresur	1,601	29-8-98	9-12-98	13-10-98	15-10-98	92	9	11
	5	Hebsur	2,713	24-9-98	5-12-98	19-11-98	25-11-98	229	15	26
	6	Belgali	1,053	25-8-98	5-11-98	13-10-98	15-10-98	126	6	14
	7	Amargol	1,907	1-10-98	1-12-98	20-10-98	26-10-98	60	19	42
	8	Yergupi	1,702	28-9-98	24-11-98	26-10-98	1-11-98	248	64	44
	9	Rottigvad	1,117	29-9-98	31-12-98	23-11-98	25-11-98	53	3	53
Kolghatgi .	10	Mishrikot	3,754	17-9-98	22-12-98	30-10-98	16-12-98	187	94	1

NOTE.—The varying virulence of the disease prior to total evacuation, and also subsequent to it, depended partly on the efficiency of the segregation arrangements for the sick and contacts; and partly also on conditions connected with climate and soil. A large number of cases occurring subsequent so evacuation is sometimes traceable to surreptitious re-entry.

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STATEMENT C.

Showing certain villages evacuated as soon as, or shortly after, the first indigenous cases were discovered.—District of Dharwar.

Name of Taluka.	Serial Number.	Name of Village.	Population, 1891, Census.	Date of first case of plague.	Date of last case of plague.	Date of Evacuation.		Total Number of Plague Deaths.		
						Commenced.	Completed.	Before evacuation.	While evacuation was in progress.	Subsequent to evacuation.
Hub . .	1	Nulvi	1,744	27-9-98	18-11-98	30-9-98	6-10-98	18	10	41
	2	Gabbur	363	26-10-98	1-11-98	27-10-98	29-10-98	10	4	1
	3	Agadi	876	23-10-98	3-12-98	30-10-98	1-11-98	5	1	34
	4	Kamplikop	548	20-10-98	3-11-98	2-11-98	4-11-98	7	4	3
	5	Shirgupi*	1,919	14-10-98	31-12-98	24-10-98	30-10-98	28	19	72
	6	Warur	760	6-11-98	24-11-98	10-11-98	12-11-98	1	0	6
	7	Anchatgeri	853	21-11-98	22-12-98	22-11-98	30-11-98	5	1	2
Kalghagi .	8	Begur	1,209	6-11-98	9-12-98	11-11-98	15-11-98	28	18	28
	9	Tabakadhonihath . .	1,255	6-12-98	12-1-99	6-12-98	16-12-98	3	5	5
	10	Hunshikath . . .	362	28-12-98	28-12-98	28-12-98	28-12-98	1	0	0
Bankapur .	11	Adisomapur . . .	781	12-10-98	30-10-98	13-10-98	20-10-98	6	3	4
	12	Mattikatti	1,166	25-10-98	28-10-98	25-10-98	28-10-98	1	4	33
	13	Hireharkuni . . .	1,850	17-12-98	11-1-99	18-10-98	19-12-98	6	4	19
	14	Shahabazaar . . .	4,632	25-12-98	12-1-99	27-12-98	8-1-99	1	27	3
	15	Shigaon	4,864	29-9-98	19-11-98	6-10-98	15-11-98	1	15	36

Note—In this category fall all villages attacked subsequent to the disappearance of the obstacles to rapid evacuation, either climatic, administrative or local. Complete evacuation was carried out with little delay.

* No 5.—The large number of deaths in this village after evacuation is due to surreptitious entry encouraged by heavy rains.

MAJOR CORKERY, I.M.S., called and examined.

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2227. (*The President.*)—You are a member of the Indian Medical Service and Civil Surgeon of Dharwar?—Yes.

2228. And among your other offices you have charge of the jail?—Yes.

2229. From what districts are the prisoners received?—From Belgaum and Dharwar.

2230. What is the number of prisoners that you can accommodate?—We are only supposed to have 300.

2231. What are the limits of duration of the sentences?—We have some life-term prisoners, but it is only temporary.

2232. What is the shortest period?—We have them even for one day. We do not keep a lifer there for any time. At the first opportunity we get we send them to other jails—particularly the Andamans.

2233. You have had several cases of plague in the prison?—Six.

2234. Were they prisoners or warders?—The first was one of our cooks.

2235. How long had he been in the prison?—Eight months.

2236. On what date did he become ill?—19th October 1898.

2237. Is a prisoner allowed to go out of prison for any reason?—Only on extramural work. But we have not had any extramural work since plague broke out.

2238. This man did not go out?—He was one of the cooks and always employed in the jail.

2239. You have made enquiries as to the manner in which he became infected with plague?—Yes, we tried to.

2240. Plague was prevalent at the time?—Yes.

2241. What was the result of your enquiries?—No certain theory. One has heard of the grain theory, but it is exploded, I think. He had nothing to do with the grinding of the grain; but the grain was brought by the contractor from Dharwar market where dead rats had been found about a fortnight previous. None of the other persons who were grinding grain were attacked; and this man simply baked and handled flour.

2242. He would not be so much subjected to this cause of infection as others?—No. We had two warders of the establishment who died. One man I eliminate, because he had been in the observation ward and had not entered the jail for about a fortnight or three weeks before he died; the other was on duty and employed inside the jail. The only theory was that he may have slept in this ward where the first case occurred. He was living out in the Dharwar District. One week he was on day duty and the next week he was on night duty. He was employed on day duty at the time he was taken ill.

2243. Did you discover any facts as to the possibility of his being infected outside of the prison?—No, he absented himself and then we heard he had died of plague, and they were all the particulars we obtained.

2244. You do not know whether he went to any plague-infected house?—Except that where he lived there was plague all round.

2245. You did not know of any of his relatives having been affected?—They were said to have died.

2246. What relatives?—I think his wife, but I am not certain.

2247. Do you know how long previously?—No, I do not.

2248. This warder became infected outside?—He probably slept in one of these rooms. The infected prisoners never reported that they became ill. Before we found them out they were lying asleep feeling seedy. It was only after they were discovered in high fever that we found out the cases. I think the warder must have rested himself during the day, because he absented himself without giving any warning.

2249. You think he slept in the same place as the man who died?—Yes, he had a large quarter to look after where these cells were.

2250. Now as to the next case?—The second case among prisoners was amongst the men who were kept under observation. We keep all new prisoners under observation in case they are incubating. This case occurred in the observation ward, so that he probably brought the disease from Hubli. The third case of a prisoner was a baker, and the cell in which he slept was twenty yards away from the

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cell where the first prisoner was attacked. The fourth prisoner was attacked on the 28th; he was a few yards away from the third prisoner's cell; and the last two were convict warders, one being attacked on November 3rd in a cell opposite to the block in which the first two cases occurred, and the other being attacked on November 9th in a cell adjoining that of the warder attacked on the 3rd. Five of the cases among prisoners practically occurred in jail and one outside.

2251. Each of these prisoners had opportunities of coming into contact with each other prior to developing the disease?—We segregated those who slept in the same room at once. There were nine cooks employed; the moment I got the first case I segregated the other eight. The same remark applies to the bakers. There were 10 bakers, and they were all segregated when the first case occurred, so that they had no communication with others.

2252. How do you think the disease extended after its introduction?—I think it was impelled along the ground, because we had some plague in Sukkur, and we found it spread in that way, and then it went to the opposite side of the street.

2253. There is no means of the people who were successively affected coming in contact with each other?—No, they were promptly segregated and put in another cell altogether.

2254. Were there different attendants for them?—I enquired every day of the jailor, and found they got their food from a separate man.

2255. This man did not come into the jail at all?—Except for distributing their food.

2256. He was only kept for that?—Yes.

2257. Is there evidence of the death of rats in the prison?—No.

2258. Not before?—Nor after.

2259. Nor up to the present time?—No.

2260. You had only six cases?—Only six.

2261. And the measures which you adopted appear to have been effective?—Yes.

2262. Were these the only measures which you adopted?—We inoculated all the prisoners afterwards.

2263. Do you remember on what date?—On the 23rd of October the first two men came forward; I tried to persuade them, but they were rather inclined to be mutinous. The two men came forward and were inoculated. The whole of the inoculations were completed by the 6th November. There were three hundred and seventy-four prisoners.

2264. You adopted three kinds of measures—isolation, inoculation, and disinfection?—Yes. I disinfected the rooms. The sixth man was the only man who was inoculated; he recovered and is now at work again. The first five uninoculated died.

2265. When was the inoculation done on the sixth case?—It was done on the sixth and he was attacked on the ninth.

2266. (*Mr. Hewett.*)—I think you said you had some experience at Sukkur?—Yes.

2267. Were you there as Civil Surgeon?—Yes.

2268. There was a violent outbreak of plague there?—Yes. It began in February 1897.

2269. Was there a large mortality among the rats in Sukkur?—Fearful.

2270. Was there a temple in which dead rats were found?—Yes. Thirty-five dead rats were taken out of that. That is, where we first traced them out; they got convulsed and died.

2271. Had there been any plague up to that date?—When we entered the temple we found three people there, and a little further on two more. Three were dead. The whole five died eventually.

2272. There is no proof from that that the advent of rats preceded the plague?—No.

2273. You found them concurrently with the outbreak of plague among human beings?—Yes.

2274. (*Dr. Ruffer.*)—Did you say you believed that the infection travelled along the ground?—Yes.

2275. How do you think it travelled along the ground; by the wind?—Yes; I think so. It is supposed to travel from room to room; how it goes there no one knows. In Sukkur it was just the same; sometimes it missed one door and attacked the third, and then went across the street.

2276. I do not understand how the living bacillus can travel along the ground?—It may be blown by the wind. We found in Sukkur they went from north to south.

2277. Then it would go in a straight direction. How did it go in the jail?—It travelled from north to south in the jail.

2278. Were the warders inoculated at the same time as the prisoners?—Yes, in batches. We could not inoculate them all at once, because we had to keep so many on duty to guard the prisoners.

2279. Finally they were all inoculated?—Yes.

2280. Where was the man inoculated who got plague after inoculation?—In the left arm.

2281. Where did he get the bubo?—In the left femoral. It is still indurated.

2282. Had he any lesion in the left axilla?—No.

2283. (*Mr. Cumine.*)—When the outbreak began in the jail, were the police of the town infected?—They were.

2284. And you had a police guard over the jail?—Yes.

2285. And I suppose the warders associate more or less with the police guard?—Yes.

2286. Is not the door of this cell, where the cook, who was the first attacked, slept, opened about 2 in the morning, in order that he may get up and get ready quickly?—Yes.

2287. Then supposing there was a lazy warder who wanted to have a sleep, that would be about the only cell he would be able to get into to lie down and have a sleep, the one which was opened at 2 o'clock in the morning?—The moment it was opened they were marched across to the cookroom—the bakery is separate.

2288. Was the cell left open?—Yes.

2289. There would probably be a connection between the cooks and the bakers as their trades are more or less allied?—Only at the time they have their food.

2290. Would the cooks and the bakers eat together?—Yes.

2291. But the other prisoners would not?—They would be put in line and all arranged in rows.

2292. But considering the similarity of the employment would not there be more likely to be association between the cooks and the bakers than between them and anybody else?—No. At the evening meal they mix indiscriminately, but are arranged in rows at the time of eating.

2293. If the cooks wanted any implement of their trade, they would very likely go to the baker to get it, or *vice versâ*, would not they?—Yes, except that the bakers make bread for outside parties and not for the prison.

2294. Then the sixth case, I think, was the case of the inoculated man?—Yes; the fifth and the sixth were two convict warders who slept in cells adjoining each other.

2295. Were they likely to associate with the police and to rub shoulders with the police?—No, except on passing through.

2296. At any rate were they in a position to have gone into the cell which was opened at 2 o'clock in the morning and lie down there?—Yes; they had two hours' watch and two hours' relief, and so on. They have no fixed place to sleep in.

2297. The convict warders are of course constantly rubbing against the prisoners?—Yes, they are prisoners themselves.

2298. Then might they have rubbed up against this inoculated man who got the plague?—The two last were convict warders, and were pals; they might have done so. The first convict warder was attacked on the 3rd November—that is the fifth case,—and the second convict warder on the 9th November, that is, six days between.

2299. The moment you discovered that the convict warders, or the cook, or the baker, had got plague, you removed them?—Yes.

2300. But whilst they had plague in them, till you had discovered it, they were going about their ordinary duties?—Yes. As soon as we noticed ordinary fever in them we moved them outside the jail to the ward called the observation ward; we had to get a special police guard during the time they were at the Plague Hospital, and a stretcher to remove them.

2301. Before you had discovered that they had got plague, they had already got high fever and a bubo?—In five cases they had at the time we discovered them. One case was one of high fever and I watched him for a day.

2302. Do you think there might have been infection by human beings—the police, the warder, the cook, the convict

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warders sleeping in the cooks' room, then the cook going into the baker's room or the baker going into the cooks' room, and then this night-warder taking a nap in the cell ?—Oh, yes ; with these last five cases. Of course, once you trace the origin of the first case the rest is easy.

2303. (*The President.*)—You did not mean to exclude the infection by human contact when you spoke of the infection travelling along the ground ?—No ; although they got strict orders not to go in they did go in, and sleep there on the quiet.

2304. (*Mr. Hewett.*)—Have you any authority in sanitary matters within the Municipality ?—No.

(Witness withdrew.)

MAJOR T. H. HARDY, I.S.C., called and examined.

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2305. (*The President.*)—You are Chief Superintendent of the plague operations in this city ?—Yes.

2306. In connection with your duties you have acquainted yourself with the general sanitary conditions and arrangements in Dharwar ?—Yes.

2307. Will you give us your opinion in regard to the habitations generally and especially in regard to their ventilation and lighting ?—The lighting is absolutely *nil* in a large number of cases unless the front door is opened. Of course some of the better houses, the double-storied houses belonging to the wealthier classes, have windows, but plague has not been among them so much.

2308. What is the character of the great mass of the houses ?—They are small, low, tiled houses, with only one entrance ; about half have a back door as well.

2309. And no window ?—No window. There are a few windows, but they are generally all shut up.

2310. Can you tell me what is the source of water-supply of the town ?—Practically two wells, one on the east side and one on the west. This is the drinking water.

2311. And independently of that there is no water-supply ?—There is another water-supply of washing water, a good many houses having wells in their own compound. Besides that, there are two big tanks, one on the east and the other on the west.

2312. Are you aware if the drinking supply has been examined by any expert ?—No. I do not think it has : not since I have been here.

2313. Can you tell me if there are any public latrines ?—There are five public latrines, two with ten seats and three with six seats ; they are on the south of the town ; besides that, there are two trenches capable of holding about 20 seats.

2314. That of course is quite inadequate for the large population ?—I take it that there is accommodation for 600 people per diem at the outside, and as the population is supposed to be 35,000 when they are all here, that means accommodation for each man about seven times a year. Then they have pit privies ; this is the ordinary sanitary arrangement of the town ; in fact, there is nothing else but pit privies. These pits are about 15 feet deep and 2 or 2½ feet wide, just outside the house in the back-yards. When they become full, within 2 or 3 feet of the top—I have seen some of them quite close up to the top—I am told, although I have never seen it done, that they put salt and lime into them and fill them up with earth. They are not emptied.

2315. Do you know if any of these privies are inside the dwellings ?—Yes, I have seen them inside some of the houses.

2316. They are very offensive ?—Certainly, they are very offensive to my mind.

2317. What is the nature of the drainage ?—There are a few main drains down the main streets, but they are not all put in the proper place ; I mean to say, they are not made properly from an engineer's point of view : the slope is not correct.

2318. Are they open or closed drains ?—Open, but those in front of the houses have a few slabs put over them.

2319. Are they well laid ?—No. The foundation is flat stones laid along the bottom.

2320. Are the stones cemented together ?—No.

2321. The drains have large crevices, I suppose ?—Yes, and the water sinks through those and fouls the soil underneath.

2322. Are they often foul within your observation ?—Some of them are. We only have about one-third of the population here, and of course I cannot tell what it is like when the full population is here.

2323. (*Mr. Hewett.*)—I believe these pit privies are so situated that they are likely to and must contaminate the well water ?—I am given to understand they do not use that well water in their own compounds for drinking.

2324. But there are wells there, though they are nominally not used ?—Yes, you see a good many of these wells in the compounds.

2325. Which may be used for drinking water ?—Yes.

2326. And that would be contaminated ?—I am not a geologist, but I should think so.

2327. (*The President.*)—Do you know whether they are ever used for drinking purposes ?—I am told they are not used for drinking, but of course one does not know what the lower classes do.

2328. (*Mr. Hewett.*)—We have had a description of the plague operations in Dharwar ; you have been responsible for the disinfection operations here ?—Yes.

2329. What measures have you adopted for disinfection ?—First of all the houses of these inhabitants and all the clothes are disinfected in a solution of perchloride of mercury.

2330. Where is that disinfection performed ?—Outside the house.

2331. Immediately outside ?—Yes ; if a plague case occurs, the inhabitants are sent to the segregation camp, and brushwood is put on the floor, and in the corners and crevices of the house, and burnt, and a man is set to watch it so that the house does not catch fire ; when this is done perchloride of mercury, 1 in 1,000, is squirted all over the rooms.

2332. By what method ?—By a Chinese pump.

2333. This has been done to all the house in the town ?—No, the Municipality could not run to that.

2334. In how many houses ?—In all the house where plague has occurred.

2335. Not in the houses, which have been evacuated because the locality was infected ?—In some of them.

2336. To what extent has it been done in those houses ?—I should think certainly one out of two vacated.*

2337. When a house has been disinfected, not an infected house but one in an infected locality, do you not let the people back again if they have not been inoculated ?—No.

2338. Is this because you do not believe in the disinfection ?—They are not allowed back unless they are inoculated in any case.

2339. If the disinfection were a protective to the locality, you could let them back without their being inoculated ?—No, not here, because we are peculiarly situated. People have gone out of Dharwar carrying plague with them and we cannot tell how far plague is reaching still.

2340. You suspect all the people who return ?—Everybody that comes into Dharwar is looked upon with suspicion.

2341. How long do you propose to maintain this rule that a man cannot re-occupy a house in Dharwar without an inoculation certificate ?—I think the idea is until the population comes back.

2342. How long do you think it will be before they come back ?—They are coming back now at the rate of 600 a week and there are about 20,000 away.

2343. It will take several weeks ?—About five months. They *may* come back in one flood.

2344. But if they do not, the rule will be maintained practically for the whole of the winter ?—Undoubtedly.

2345. (*Dr. Ruffer.*)—I understand your disinfection pump is simply a spray ?—No, it comes out in a strong stream.

2346. Do you rub it in with a brush or in some other way ?—No.

2347. Do you flush the place with water after disinfecting with perchloride of mercury ? No, the stuff runs on the floor and is swept on again. There are ten buckets for one house : some people want more, and it is all expended on the house ; so it floods the ground.

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* Note by witness, dated 12th February 1899 : " Since the Plague Commission's visit here all vacated houses have been disinfected."

Major Hardy.

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2348. It streams down the wall and floods the ground, and there it stays?—No. It is brushed all over the ground.

2349. But after you have finished with the mercury do you wash down the walls with water?—No.

2350. You leave it in?—Yes.

2351. (*Mr. Cumine.*)—Are the majority of these uninoculated people of Dharwar outside the town in huts or inside the town in houses?—The majority are outside the town in huts; there are a few uninoculated people in the town and we try to trace them of course.

2352. Have you observed any tendency amongst these uninoculated people in huts to come, when plague has seized them, into the houses in the town to die?—Yes, some have done so; we had a case last week on the 5th December. A man came in about half past eight at night and died the next morning; he had a bubo on him.

2353. Have you noticed that tendency to a large extent?—No, they are afraid to come in, but there are certain cases.

2354. When you find a man dead in a house, do you find on looking in your census or making enquiries that he has come in from the huts outside?—In a great many cases I have found that out; I have found a case about a month ago. The house was supposed to be vacant; I was going round making a house-to-house inspection, and I came across a sick man and sent him to the plague hospital, where he died the next morning. In another case I saw a man come into the market, and thinking he looked seedy I sent him to the plague hospital. He died within 14 hours.

2355. People who came in from outside to die in the town do not belong to the uninoculated in the town?—No, they do not.

2356. If the mortality of the people from outside who came and died in the town is saddled upon the uninoculated people in the town, would not that produce a misleading deduction as to the rate of mortality amongst the uninoculated people in the town?—Undoubtedly. In the last fortnight nearly all the cases were imported.

2357. The uninoculated deaths are imported?—Yes.

2358. They are not of uninoculated people living in the town?—No, not now. We had some cases among the inoculated about three weeks ago.

2359. Were you in Hubli at all?—No.

(Witness withdrew.)

MR. R. HORNABROOK, M.B., recalled and further examined.

Mr. R. Hornabrook.

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2360. (*The President.*)—You have had a very large clinical experience of plague?—Yes.

2361. Can you tell me the average duration of the fatal cases?—It has taken from three to four days from the very commencement of the attack—not the hospital duration.

2362. It is not so easy to tell the average duration of non-fatal cases?—The time from the commencement of the attack until the patient is really out of danger is from 10 to 15 days; he ought to recover after 10 days.

2363. Of course it is very often protracted beyond that time?—Yes.

2364. Especially because of the buboes?—Yes, exhaustion caused by high temperature and buboes.

2365. Have you seen any particular permanent nervous effects following plague?—They seem to be altered mentally, but I should not like to say it is permanent.

2366. Has there been any paralysis?—No.

2367. No symptoms like those of spinal disease?—No.

2368. With regard to buboes, can you tell me in a general way what is the number of buboes you encounter in individual cases?—As a rule you get one bubo only, but you may have any number. The most I have ever had in a case was 17. I have had 10 in one case, in another eight, and three and four frequently.

2369. I suppose they are scattered in the different regions?—Yes, they generally come one after the other.

2370. I suppose sometimes they come when a patient is apparently recovering?—Yes, when a patient is practically out of danger he may get one.

2371. What is the general fate of the bubo?—As a rule it suppurates. Inoculated cases very often do not suppurate; they subside.

2372. Have you often to interfere surgically?—I always open a bubo when there are signs of suppuration.

2373. I suppose you have paid much attention to the points of infection in these patients?—I have searched for them.

2374. And where have you generally found them?—Generally in the lower extremity, generally in the sole of the foot, some times up round the knee; and I have seen them in the arm. They are not frequently found.

2375. When they are found, are they sometimes very obvious?—Yes.

2376. What is the kind of appearance you see?—You see a small vesicle, and in the vesicle there is a slough which comes away in three or four days, leaving a raw surface. It heals up quickly. I have always found the gland near the point of infection; if the foot is affected, the gland is always in the femoral region.

2377. Have you seen much of the pneumonic form?—I have seen a great deal.

2378. Is that frequently or very rarely attended with buboes?—Rarely.

2379. What do you consider the average duration of the pneumonic form?—About 48 hours; it is generally fatal in about 48 hours.

2380. Have you had any recoveries?—I believe only one. Among my hospital servants I have had four cases and none recovered.

2381. It is very fatal?—Yes.

2382. Have you any special observations to make on the protective effects of inoculation in pneumonic cases?—The following are particulars of admissions, recoveries, and deaths among pneumonic plague cases admitted into the Dharwar Plague Hospital:—

	Not inoculated.	Once inoculated.	Twice inoculated.
Recoveries . .	4	2	1
Deaths . .	25	2	3

Among 630 uninoculated plague cases admitted into hospital there have been 29 pneumonic plague cases, of whom 25 have died and four recovered: the percentage of pneumonic plague cases on 630 admissions being 4·6 per cent. Of 86 once inoculated cases admitted, there have been four pneumonic plague cases, of whom two have died and two recovered: the percentage of pneumonic cases on 86 admissions being 4·65 per cent., practically the same as among the uninoculated. Of 20 twice inoculated cases admitted, there have been four pneumonic plague cases, of whom three have died and one recovered: the percentage of pneumonic cases on 20 admissions being 20 per cent. The percentage *death* rate for the same three divisions of cases admitted into hospital is as follows:—

	Cases.	Deaths.	Mortality.
Uninoculated . .	29	25	86·2 per cent.
Once inoculated . .	4	2	50 ,, ,,
Twice	4	3	75 ,, ,,

Of pneumonic plague cases outside the Plague Hospital, I have been only able to obtain the results of *double* inoculation. They, however, serve to support the hospital figures: for of 23 that have occurred *outside* the hospital, 17 were fatal; and of these 17, 14 died of pneumonic plague. The percentage of pneumonic cases on 23 plague attacks among the *twice* inoculated outside the hospital was 60·8 per cent., and the percentage *mortality* among these twice inoculated cases attacked with pneumonic plague was 82·35 per cent., nearly as high as the uninoculated pneumonic cases admitted into hospital, and slightly higher than the twice inoculated pneumonic cases admitted. It is interesting to note that of the two *once* inoculated pneumonic cases that *recovered* in hospital, one was attacked *one* day after inoculation and the other four days after inoculation; whereas of the two that died, one was attacked 70 days after inoculation and the other 87 days

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after inoculation. Did the first two recover, because they had been *recently* inoculated? In taking the four twice inoculated cases attacked with pneumonic plague and admitted into hospital we have the following:—The *one* that *recovered* was inoculated for the *second* time 12 days before being attacked with pneumonic plague: of the three that died, one was inoculated for the second time 91 days before being attacked, another 89 days, and the other 85 days, giving practically the same result as occurred among the once inoculated. As far as my personal experience has taken me, it appears that in proportion to the number of attacks the pneumonic plague seems little influenced by inoculation. This especially applies to cases that have been inoculated some time previously.

2383. Have you had any experience of inoculation as a curative measure?—No, I have not.

2384. After an attack has occurred have you any experience of the injection of Haffkine's fluid or any serum?—No, I have not.

2385. (*Dr. Ruffer.*)—You have inoculated a great many people?—Yes.

2386. And I believe some of your staff have been inoculated?—Yes.

2387. Have you noticed any effects especially on Europeans after the inoculation?—I have not seen any. My European staff who were inoculated were inoculated some time before I saw them.

2388. Have you seen serious symptoms after inoculation, any very definite cases?—I cannot say that I have seen any definite case. I have had very serious cases who have died within a few hours after inoculation. I can put all these papers in. I have two or three abortion cases. I have one rather interesting case to show you of a patient who refused medical advice. We never forced medicine on them at all, but only 15 refused, of whom 14 died. There was one case here who refused medical advice for four days and was very seriously ill. It shows the effect of getting the bowels opened. I succeeded in doing that on the fifth day and the temperature fell at once, and this was the result. In the cases which were admitted within 24 hours I have 50 per cent. of recoveries.

(Witness withdrew.)

(Adjourned till to-morrow at Hubli.)

At The Railway Station, Hubli.

NINTH DAY.

Friday, December 9th, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

MR. E. S. CHENAI called and examined.

Mr. E. S. Chenai.

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2389. (*The President*).—Will you kindly tell us your medical qualifications?—I am a Licentiate of the Royal College of Surgeons, Edinburgh, Licentiate of Midwifery, Edinburgh, and L. S. A. of London.

2390. And what is your appointment here?—Chief Medical Officer of the Southern Mahratta Railway.

2391. I believe you have had an opportunity of observing the first case which occurred in this district?—Yes.

2392. Will you give us an account of what you noticed?—When the plague broke out in Bombay in 1896, I used to keep a watch, preventing passengers entering the junction station at Poona.

2393. Did you make a personal watch?—Medical inspection—to watch the passengers. We prevented about 100 passengers at the end of 1896 entering the Southern Mahratta Railway carriages.

2394. Why did you prevent them?—According to the Epidemic Diseases Act people suffering from infectious diseases are not allowed to enter a railway carriage or yard.

2395. You found them suffering from infectious disease?—Yes.

2396. What did you do with them?—We prevented them from entering into the railway carriages and sent them to the Sassoon Hospital, Poona; that was about the end of 1896. In February 1897 a woman came from Bombay to Hubli suffering from high fever. She was detected here. She was coming to live in the railway chawls. She had been to Bombay to bury some relative who died of plague there. After performing the funeral ceremonies she came back to Hubli. This was on the 15th February 1897. I found her here suffering from fever and she was sent to the segregation hospital and treated there. She was discharged cured in about two months' time. From February to October there was not a single case. Again on the 15th October I detected a Muhammadan suffering from plague in the railway chawls.

2397. Were they under regular inspection?—There was no medical inspection at that time.

2398. Did you cease to examine passengers by the railway at that time?—We used to examine passengers at that time; on making enquiries I found that people suffering from plague came from Sholapur and lived with their relatives in the chawls.

2399. They were not detected in the railway here?—No; I do not know how they came, whether by road or rail. In the chawls many people began to die; the death-rate was more than usual in the month of October, and that is how it attracted my notice. Then I gave intimation that all cases of fever, however trivial, must be reported immediately to me. This man, whom I detected on the 15th October 1897, was brought to my notice as suffering from high fever. On the 17th I found a bubo developed, and I gave intimation to the Collector and to the plague authorities concerned.

2400. Did you find other cases after this one?—Then we started house-to-house inspection in the chawls and soon after this case many cases began to occur.

2401. How did you deal with the plague cases which occurred?—My duty was to send them to the Government Plague Hospital. There were Government officials appointed and they treated all plague cases. We only sent cases to the Government Plague Hospital.

2402. They removed them from the chawls?—They were removed by the staff I kept.

2403. What was done with the chawls?—We removed all the inhabitants and camped them in the fields. We removed the crops of fields. The crops were very high. House-to-house inspection was at the same time started as well as the inspection of the people in the camp fields.

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2404. Did you disinfect the houses ?—Yes, we disinfected all the houses ; as soon as a case of plague occurred, we removed all the tiles and sprinkled disinfectants over the floors, and burnt all the things on the floors.

2405. Were these means effective in stopping the epidemic in the chawls ?—Yes. There was a segregation camp in the Plague Hospital compound where we sent persons living in the same house when a case of plague occurred.

2406. This preceded any out-break in the town proper I believe ?—This was before it broke out in the town.

2407. Can you trace the commencement of plague in the town outside of the railway premises ?—Outside the railway premises it occurred in this way. A police constable had a relative living in the town going and sleeping with him ; he was keeping a watch over the chawls, and that man used to go and live in the town, and that is how it spread in the town.

2408. (*Mr. Hewett.*)—On what date in October 1897 did these people come from Sholapur ?—They came before these cases took place.

2409. When did the people return back into the chawls after evacuation ?—In the month of March.

2410. That was before the second outbreak in the town ?—Yes.

2411. Did you have any more cases in the chawls after they were re-occupied ?—Two.

2412. When did they take place ?—In June. The first case was on June 11th.

2413. The second outbreak in the town appeared, I believe, among the coolies working on the railway ; are these men brought from outside or do they belong to Hubli ?—They are the residents of Hubli.

2414. You are certain of that ?—Yes.

2415. The railway would not bring them from outside ?—No ; in fact, there was a strict watch at that time. Ou employés here are the local residents.

2416. (*Mr. Cumine.*)—Did these Sholapur people who came develop plague here ?—I cannot say. Some people died here, but they were not railway employés.

2417. Were they Sholapur people ?—Yes.

2418. Did the relative of the constable who came and slept with him and then went into the town develop plague in the town ?—I think so.

2419. After the people came back to the chawls two cases developed in the chawls ?—Yes.

2420. It was over two months after their return that the cases occurred in the chawls ?—About that.

2421. And at the time the cases occurred in the chawls was there a lot of plague in the town ?—There was a lot of plague in the town ; it was very high.

2422. Had the coolies amongst whom it burst out here relatives in Belgaum, do you know ?—I do not know.

2423. You do not know that the coolies here have generally relatives in Belgaum ?—I cannot say. I do not think they come from Belgaum ; we do not allow people to come to work here from Belgaum or other places.

2424. Do you have to send coolies up to Belgaum to make repairs or anything of that sort and then come back again ?—I cannot say that.

2425. (*Dr. Ruffer.*)—When did you evacuate the railway chawls ?—On the 25th October at first.

2426. You sent these people to the segregation camps ?—Yes.

2427. What was the mortality in the segregation camps ?—I do not know ; Dr. Meyer will tell you.

(Witness withdrew.)

ASSISTANT SURGEON D. CARDOZ recalled and further examined.

Assistant Surgeon D. Cardoz.

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2428. (*The President.*)—The Commission wish to get further information with regard to inoculation and this outbreak. With regard to inoculation, can you tell me what means you employed to induce the people to be inoculated ?—We began inoculations twice, so to say. At first we had a very few cases and at that time there was no inducement made to the people. It was given out to them that it would confer a certain amount of immunity. That was about the beginning of January 1898. As there were not many cases of plague occurring at that time there were not many who came forward. Then we had a Medical Officer, Major Collie, in charge, who was relieved by Dr. Leumann, and the latter did not at first care to do any inoculations. But after talking over the matter for a long time he came round to believe that it was well that it should be done, and we began the inoculations about the end of May or the beginning of June. Then there was some inducement offered to the people. It was notified to them that if they offered themselves for inoculation twice, certificates to that effect would be given them, and that these certificates would enable them to travel more easily from place to place, and that there was not much likelihood of their being detained. That was one inducement. The second inducement was that the inoculated people would not be segregated for any length of time, but that it would, however, be necessary to send them away in case their houses were infected for a short time till the latter were disinfected. The third inducement was that medical opinion was in favour of inoculation, and that it was generally believed that it conferred some immunity. Then, fourthly, some leading men, who were appointed Superintendents in the Health Department, were asked to give a lead in the matter of inoculation by offering themselves for the operation.

2429. When people arrived in the town either by rail or by road, what did you do with them in regard to plague ?—At the time the epidemic was prevalent we usually sent the people to the health camp and kept them there generally for a period of ten days.

2430. That is the camp about a mile away ?—About three quarters of a mile away. In that health camp there was a place reserved for observation of these passengers, and we detained them there for about ten days. If we found they did not develop any suspicious symptoms of plague, we either sent them to the town itself, or, if they were to go forward, we let them go by rail or road.

2431. You did not ask them to be inoculated ?—Oh no, not these people. We did ask those whom we sent to the health camp from the infected areas in the town. We told them that if they availed themselves of inoculation it would not only confer immunity on them, but would prevent them suffering any future inconvenience of having to go out again if more cases occurred in their houses.

2432. Did you keep these people in the camps until they were inoculated ?—We either kept them for a period of 10 or 15 days, or until such time as they had themselves inoculated. It was optional ; they went back without inoculation, but some offered themselves for inoculation. No pressure was used.

2433. Supposing they were not inoculated ?—They went after 10 or 15 days to their own places provided there was not much infection. If the place was very much infected, they were allowed to go outside the health camp and live elsewhere, but not in the town.

2434. Assuming that persons were not inoculated within 10 days after being removed into this camp, did you detain them for a longer period ?—No, we did not detain them there, but we did not allow them to re-enter the town. They left the health camp and made their own arrangements outside the town. If they could not make arrangements at once, we gave them a few days' time to live in the health camp till arrangements were made. We did not allow them to re-occupy the places unless they were inoculated.

2435. Can you give us a statement with regard to the first case of plague which occurred in the town of Hubli ?—Do you wish me to give the indigenous cases ?

2436. The first case that actually occurred ?—A Muhammadan who was a workman in the railway workshop was attacked with plague ; that was about the 4th November 1897. His case was discovered after death, and it was recorded as one of importation from the railway chawls. He, however, did not live in the chawls, but mixed really with the workmen on the railway premises, and it is supposed that he

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might have had clandestine meetings with people belonging to the chawls when they were cordoned.

2437. You mean he went to the chawls?—Either he went to the chawls, or the people from the chawls came to meet him, and interchanged things and kit. We took drastic measures on the occurrence of this case. We had no further cases in that locality. The second case was that of a Christian girl. That case was also imported into the town from the chawls. In fact, the girl was taken ill in the chawls, but was removed thence the night prior to the establishment of the cordon.

2438. Removed into the town?—Yes. In that case also rigid measures were adopted with regard to disinfection, evacuation, etc. The third case was that of another Christian who had evidently no connection with the Christian girl just referred to. It was believed that he had also had something to do with the chawl people; but we did not get very clear evidence on that subject. The fourth was a case belonging to the class of people called Waddars; he used to sell lime for whitewashing the houses, and it was found that he often frequented the railway chawls, the infected locality. He carried the lime there and stayed there perhaps for hours and slept there. The chawls were vacant at the time.

2439. Had they been disinfected?—Yes. They were being disinfected. The fifth was the case of a woman in the neighbourhood of the last case, in fact in the same compound. That might be regarded as a case which got infection from the Waddar, but beyond that there was no further spread of infection in that locality. The sixth case was a man named Siddhu. This man was a Mahratta by caste and had a relative among the police cordon in the railway chawl. Siddhu had also many friends among the people cordoned, and it was found out that he often went to those people and ate and slept with them. He caught the infection there and went into the town to his own house, where it is said he lived for a couple of days or so; and then, finding that he would be discovered and sent to the Plague Hospital, he went to one of the villages and died there. It appears to us that this case was the one which infected the locality or caused indigenous cases in the town. A few days after the death of this man two boys in the neighbourhood were attacked, and after an interval of about 23 days a man who used to live in the adjoining house, but who was at the time in the health camp, took the infection. His name was Rajba Appaji. It was proved that though Rajba Appaji did not live in the Mahratta Gali at the time of his falling ill, he went there on two occasions, probably more often, and went to his house stealthily and drank and slept there. This house was adjoining Siddhu's house. Thereafter another case occurred in an old woman not very far from Siddhu's house. A few days after that two more cases occurred almost in the same street but some distance from Siddhu's house. Then came three more cases little further on, but all within a radius of about 100 yards or so from Siddhu's house. One case, however, during this period occurred at a considerable distance away, perhaps about three furlongs, and we could not account for the occurrence of that case. We could neither trace it to importation nor to the Mahratta Gali, the residence of Siddhu. Probably, however, she had much to do with the people in the Mahratta Gali, and it is possible that she might have removed some clothes belonging to the people of the Mahratta Gali who were going out to the health camp and other places.

2440. It is not known; it is a possibility?—Yes, it is a possibility.

2441. There is nothing known?—No, not for certain. This I think stops our first infection, because in the month of February we did not have more than two or three cases; and then there was an interval of nearly 26 days, after which time some other cases began to appear in this locality adjoining the railway premises. Although I have got no data to go upon, from the conversation I had with the medical officer in charge of these operations I find it was believed at the time that the place was newly infected, probably by merchandise imported from Bombay and other places. The places which were attacked were nearest to the goods-shed; and it was also noted that the cases occurred among people who worked in the railway premises, though some of them were residents of the place.

2442. Can you tell me if there has been noticed any association between the death of rats and the occurrence or plague in this country?—So far as the infection of the railway chawls went we did not notice any dead rats in the beginning. But a week or ten days afterwards we did find some dead rats in the chawls. In the town in the beginning we looked for the rats, but found none. We only found them after the plague had assumed rather an epidemic form.

2443. In what month?—It was about the end of June that dead rats appeared here and there in the town, and as the epidemic became more and more violent dead rats were found in all the houses.

2444. I understand that several monkeys died here?—They said so, but I only knew of two monkeys which were supposed to have died of plague.

2445. (*Mr. Hewett.*)—I understand that the first case in the first infection took place on the 4th November 1897?—Yes.

2446. And the last one, the fifth case,—the case of the woman?—20th December.

2447. When did the fourth case take place, of the man who got infected from going to the chawl?—On the 14th December.

2448. Then this infection overlapped the other in point of time?—Yes.

2449. When did Siddhu get infected?—On 7th December.

2450. When were the two children attacked?—9th January 1898.

2451. Between 7th December and 9th January did you evacuate what you regarded as the infected part of the Mahratta Gali?—Yes, a part close to the house.

2452. I understand that Rajba Appaji came back to the infected part and died on the 30th January?—Yes, he was living in the health camp.

2453. He came back surreptitiously?—Yes, and lived in his house at night.

2454. Had you then had any cases in the segregation camp?—No.

2455. When did the old woman die?—She died on the 1st February.

2456. And the next two cases on the 3rd February?—Yes, about that.

2457. When did you burn the Gali down?—After this case.

2458. Immediately after?—No, some days after. It must have been about the 15th February.

2459. The only persons so far as you know from whom the two children might have taken the infection were the man and the woman in the other part of the town?—Yes.

2460. Is it at all likely that these children would have had any communication with them?—No.

2461. Could they have played about the evacuated locality?—Yes, they could have got to the house too. It was a vacant house and they could have gone on the top of it.

2462. When you burnt the place you practically stopped the infection a second time?—Yes.

2463. These two places were both in the direction of the railway chawls, were they not—the Mahratta Gali and this other portion of the town in which cases occurred during the first outbreak?—They were not quite the nearest.

2464. They were on the same side?—Yes, a little further than the nearest place.

2465. Did the second outbreak begin in the quarter next the goods station on the railway?—Yes, it is not quite nearest to the goods station.

2466. You said, with regard to the inoculation, that people were told that they would be able to travel more easily if they got a certificate of inoculation. Would they be able to travel at all if they had no certificates?—As a matter of fact, if they were inoculated twice they had a certificate.

2467. Is there any rule that they may not travel by railway unless they have certificates of inoculation?—It is a recent rule.

2468. Is it in force at present?—It is not in force now.

2469. When was it abolished?—Since this railway inspection came into force.

2470. They can travel now without a certificate?—Yes.

2471. Can people re-enter their houses without a certificate?—Yes, but our Health Supervision Establishment on finding out that a certain uninoculated person has entered the town would induce him to undergo inoculation.

2472. What is the process?—He is told to undergo inoculation, otherwise it would not be safe for himself nor for the people near him, and that if he does not get himself

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inoculated he might have to remain in the health camp for some days.

2473. I understand that you have something to do with examining the bodies of the people who died during the course of the plague?—In the beginning.

2474. Did you classify them into inoculated and uninoculated persons?—That has always been done to my knowledge.

2475. Did you take part in doing it?—Not personally.

2476. But you know the principle upon which it is done?—Yes, because I always kept in touch with what was being done.

2477. Was any body considered to have been that of an inoculated person unless the certificate of inoculation was produced in respect of it?—Unless the certificates were produced; the person was not considered to have been inoculated.

2478. The certificate was either found on the person of the deceased or was produced by his friends?—Yes.

2479. His friends were asked to give it up?—Yes.

2480. There was no inducement for them to do so?—There was no particular inducement.

2481. Is it possible that some of them retained the certificate?—I do not know; they might have done so from indifference in some cases, but there was no object in it.

2482. Might not they be able to dispose of such certificates?—No, because it was only the information we wanted; when a man is dead the certificate was of no use to the relatives.

2483. Could they not make use of them?—No.

2484. By disposing of them to some other person?—That would be dangerous.

2485. It may be dangerous, but would not a native naturally wish to retain a certificate?—That is quite possible.

2486. Is it not rather the custom of the natives to desire to retain certificates of any kind?—I do not think there have been many such instances.

2487. Is not it the case that they do like to retain certificates?—Yes, they are rather anxious to have certificates.

2488. As regards the census figures of the uninoculated persons, do you regard them as absolutely correct?—I do not think that they are correct.

2489. Do you think them too large or too small?—They are rather small. It is believed that the present population as shown in our census is much smaller than the actual population now.

2490. The uninoculated figures were arrived at by deducting the number of the inoculated persons from the assumed population, were they not?—Yes, from the population as found when we took our first census.

2491. Do you think that the uninoculated population ever fell to a thousand?—I do not think so.

2492. What do you think is the smallest number they are likely to have fallen to?—I think the smallest number would be from 6,000 to 8,000.

2493. I understand during the progress of the epidemic an endeavour was made to keep the people as far as possible in the town of Hubli or in the neighbourhood in camps?—Yes. There were not many facilities afforded them to go elsewhere.

2494. But did not many people go into the neighbouring villages?—Yes.

2495. And at the present moment, when Hubli is uninfected, a good many villages in the neighbourhood are infected?—Yes.

2496. I suppose visitors occasionally come to Hubli now?—Not occasionally; they come frequently, because it is the market town.

2497. So that all the cases in Hubli are imported cases?—Yes.

2498. And you are taking measures to prevent the possibility of another infection?—Yes, we try to do our best in that respect, but I think our efforts have not so far proved very satisfactory, because some of the imported cases have not been discovered till death has taken place.

2499. Is there any conceivable way by which you can prevent villagers from having access to the town of Hubli?—No, I do not think it is very practicable.

2500. (*Mr. Cumine.*)—There was a time in the epidemic when people were not allowed to go out without passes, was there not?—There was.

2501. And the man who had been inoculated got a pass at once?—I suppose so, especially if he was not from a locality which was much infected.

2502. If he did come from a locality which was much infected, would he get a pass if he were inoculated?—Yes, usually. If he were travelling he was stopped temporarily.

2503. Then in the case of a man who had had plague in his own private house and recovered and wanted to get out of the town, there would be an inducement to him to get himself inoculated?—If he wanted a pass, but I do not think there have been many such cases, if any, because the medicoes would not consent to inoculate these people.

2504. But how would they know that he had had plague?—Unless the man had recovered a long time previously he would look very weak, and a very weak or anæmic person is usually rejected as unfit for inoculation.

2505. Is a separate certificate given to each member of a family? Supposing a father, mother and child come to be inoculated, would each get a separate certificate, or would one certificate be given to the three?—Each would have a separate certificate.

2506. If in a house the husband were inoculated and the wife were not inoculated, would you allow the husband to remain in the house and turn the woman out?—In that case of course we were obliged to turn the woman out and the husband accompanied her, although he was inoculated.

2507. Was there any impression amongst the people that the retention by a wife of her dead husband's certificate of inoculation might possibly confer some privileges upon her?—No, I do not think there was; of course, I cannot speak from positive knowledge.

2508. You have not noticed anything of the kind?—No.

2509. (*Dr. Ruffer.*)—Do you think a great many people got inoculated in order to leave the town?—Not in order to leave the town, but perhaps to obtain certain facilities with regard to travelling and certain privileges with regard to segregation and isolation.

2510. But a certain number of inoculated people did leave the town and did not come back?—Yes, in such cases there was perhaps something in connection with some members of the family being not inoculated, or on account of sickness, pregnancy or recent delivery.

2511. A certain number of uninoculated people also left the town, did not they?—Yes, rather a large number.

2512. Do you think the number of uninoculated who left the town was larger than the number of inoculated?—I should think much larger.

2513. Do you think people sold their certificates of inoculation?—There might have been a few solitary instances, but I do not think that that practice has been in any way considerable.

2514. (*Prof. Wright.*)—When you found a dead body, did you always class it as uninoculated if you did not find the certificate; had not you a register of inoculated people?—In certain cases when it was known for certain that a person was inoculated we regarded that case as one of inoculation by reference to the record.

2515. If you knew the name of a man who died, would you look it up in the register?—If there were no certificate found; but if there was a certificate found, there was no necessity.

2516. But before you put a dead man down among the uninoculated, you would have looked him up in the register?—Yes, in the case of known persons.

2517. Are most of the bodies known?—No, most of the bodies are unknown—a very large proportion.

2518. You have said you think the uninoculated population never went down to less than 8,000 or 10,000; is that the case?—There is no definite data: it is a surmise. I put it from 6,000 to 8,000.

2519. What do you base that impression upon?—Our present population is supposed to be 44,000, and the number was before the outbreak of plague somewhere near 57,000. We assume the plague has carried away about 4,000, and that leaves us a balance of 53,000. It is believed that most of the people who left the place have returned into the town. Not only that, but the people from the neighbouring villages have entered the town and are living here, and it is supposed that the population of Hubli now is something like 52,000 or 53,000.

Assistant Surgeon D. Cardoz.

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2520. This census is made by going round from house to house every week?—Every day.

2521. Do people escape or hide themselves?—There is a chance of escape and a great attempt is made at concealment. Sometimes it occurs from neglect and sometimes from concealment.

2522. Has there been any case in which people who have recovered from plague have been inoculated afterwards?—Not known cases.

2523. (*Mr. Cumine.*)—As regards the daily census, was the census made daily or was it made once for all originally, and then deductions made for people who had gone away?—Deductions and additions.

2524. It was made once for all originally?—Yes, when we began the supervision, and then we corrected it accordingly as people came in and left the town.

2525. Who verified the fact as to whether the general supervisors corrected the census properly?—That supervision lay with the Superintendent of each division who had about five or six wards, and then the Superintendent's work was verified again by the Chief Superintendent. At present Captain Brownrigg is our Chief Superintendent.

2526. Do you know whether they paid particular attention to keeping the census up to date?—They are doing that so far.

2527. During the epidemic?—Yes, they have been doing it all along.

2528. Is the register of inoculated persons indexed?—No, it is not indexed.

2529. At one time there were many thousand names in it?—Yes.

2530. Supposing you heard the name of a man who had died of plague, how would you find out whether he was on the register if it were not indexed?—We do not look for his name: but if he were known to me, or I happened to think that he was inoculated by me, I would try to find out his name by enquiring from the people who lived near by upon what day he was inoculated, and then I should refer to the book. But such an instance is very rare. I think I had only a couple of instances of this kind. We regarded a case as not inoculated unless his certificate was found.

2531. (*The President.*)—Except in two cases?—Yes.

(Witness withdrew.)

(Adjourned to Monday, December, 12th, at Bangalore.)

At The Mayo Hall, Bangalore.

TENTH DAY.

Monday, December 12th, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT. | MR. A. CUMINE.
PROF. A. E. WRIGHT, M.D. | DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

COLONEL DONALD ROBERTSON, I.S.C., called and examined.

Colonel Donald Robertson.

12th Dec. 1898.

2532. (*The President.*)—You are the Resident in Mysore?—Yes.

2533. And you are prepared to give us evidence with regard to plague in the Civil and Military Station of Bangalore?—Yes.

2534. In the first place will you tell us what is meant by the term "Civil and Military Station"?—The tract with which we are dealing, the Civil and Military Station of Bangalore, has been assigned by the Mysore State for administrative purposes to the British Government. It comprised 12·93 square miles, with a total population, civil and military, of 100,081 persons (Census of 1891). It is included within the coloured part of the map which I put in.* The District Magistrate is *ex officio* the President of the Municipality, the limits of which are conterminous with those of the station. Excepting in regard to judicial matters, excise, land revenue, income tax and sandalwood working, the executive management of the station vests in the Municipal Commission. There is a large garrison, but no cantonment in the technical sense of this word as applied to various places where there are troops in Northern India. The duties of the General Officer Commanding are exclusively military.

2535. What are your functions?—The Resident exercises the functions of a Local Government and has under the Municipal Act large powers of intervention; the initiative, however, in almost every matter rests with the Municipality. Throughout my evidence I propose to deal only with the Civil and Military Station—leaving the Plague Commissioner (Mr. V. P. Madhava Rao) and the other Mysore witnesses to speak as regards the outbreak in the Bangalore City and other parts of the Mysore State.

2536. Are you aware if in the native portion of Bangalore measures were adopted on the same lines as in the Civil and Military Station?—Yes. It is an accepted principle that the plague measures in the Bangalore City and the vil and Military Station shall run as far as possible on identical lines. In one or two instances the Government of India have allowed certain relaxations as a rule as regards the Bangalore City, but for the most part the measures are identical. The Darbar recognizes that this must be so looking to the fact that Bangalore City and the Civil and Military Station practically comprise one city, the divisions between both centres of population being entirely artificial.

2537. When did the first case of plague occur in the Civil and Military portion?—On the 12th August 1898.

2538. Will you give us the history of the case?—The first case of plague, an imported one from Hubli (August 12th), was that of a servant of Mr. Willans, a railway official just returned from Hubli. He was taken ill before he had left the railway premises, and was sent by his master, who apparently suspected nothing, to his bungalow in the Civil and Military Station. The sufferer was taken by Lieutenant-Colonel Benson, who lives close by, to the Darbar Hospital near the City Railway Station, where he eventually died.

2539. I understand this servant had been at Hubli?—He had been at Hubli with his master for about three or four days.

2540. Immediately before 12th of August?—He returned on the 12th August from Hubli.

2541. When was the case removed by Lieut.-Colonel Benson?—He heard of it late at night; I think on the night of the 12th, but I am not quite sure about that. He lives quite close by and the news was taken to him that a man was believed to be suffering from plague. He drove up in his carriage to the servant's master's house a few doors off and at once took off the man to the hospital in the city.

2542. It was then recognized to be a case of plague?—Yes, he believed it to be a case of plague. I do not think he was absolutely certain in his mind, because he had seen very little plague up to that time. But he had very great suspicions that it was a case of plague.

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* Not printed in the Commission's Proceedings.

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2543. Can you tell me if anything was done to prevent the spread of plague from this case?—Yes. The house was at once disinfected and all the servants of Mr. Willans were taken to the segregation camp.

2544. The house was disinfected?—Yes; the roof was not taken off. It was a bungalow. I am not sure whether the case was in the servant's house, but I know the house was disinfected and the servants were all carried off to the segregation camp. We were entirely free from plague in the Civil and Military Station after that until the 15th of September.

2545. Then your second case of plague occurred?—The second case occurred on the 15th September; and it was a case which had evidently strayed from the city.

2546. At that time there was plague in Bangalore City?—Yes.

2547. Can you give us any particulars about this second case?—No, I am afraid I cannot. I left all the details of cases and hospital treatment to Surgeon-Colonel Dobson. I am afraid I can give no details of any of these other cases which occurred, except that I know most of the first cases which occurred were people who had strayed in from the city.

2548. Do you know if the plague extended from the second case through the Civil and Military portion of the city?—No; the first case was on the 15th, the second on the 17th and the third on the 30th. The first two cases on the 15th and the 17th were imported cases, and the first indigenous case on the 30th was in the Circle of Blackpully.

2549. I suppose similar measures were taken in these cases?—In any case of which we could get notice; the medical measures recognised as suitable for dealing with plague were invariably taken.

2550. Now, will you kindly inform us what the administrative measures were?—The first steps taken were the provision of two hospital camps which were at first of small dimensions but subsequently enlarged from time to time. They are called the North and South Camps. The idea was at first entertained of having a hospital camp and an observation camp and a contact camp. But almost immediately the epidemic commenced, the idea of an observation camp was given up. We found that it was extremely difficult to get any one to segregate, and drawing a fine distinction between observing and segregating seemed under the circumstances useless. We therefore confined our measures to putting certain people in hospital and segregating those who were brought in contact with them. At the same time the health camp about two miles to the east of the station was made, which is capable of accommodating about 400 people, and on a site which admitted of indefinite extension.

2551. Did you have much difficulty in inducing people to adopt the measures?—We were unable to induce anybody to resort to the health camp, mainly I think because, firstly, the people regarded the health camp more or less as a hospital, and, secondly, the weather had been very bad here; we have had an almost continuous monsoon from the south-west followed by the north-east during the whole progress of the epidemic. It has been entirely unsuitable for camping out.

2552. I believe you also divided the station into sections?—Yes, the whole of the station was divided into 14 circles and each circle was sub-divided into a certain number of blocks. The total number of blocks for the whole station was 162; each block was managed by a supervisor and each circle by a Superintendent.

2553. What was the population of each of these blocks?—We have got the population of each circle; the idea was to give each supervisor about 100 houses; it would be difficult to maintain any accurate division of that sort, and subsequently when the epidemic became very bad the arrangements were revised and the circles were doubled up. We have at the present time to maintain the blocks as originally fixed, although the circles have been changed. We have diminished the number of circles, because our Superintendents were at first a voluntary agency, and the supervisors only were paid. As soon as the epidemic began to press severely in places, the voluntary agency failed entirely. Some resigned and some ran away. We were then obliged to resort to paid agency. It would have been impossible to obtain at that time on a pinch 14 educated men who were willing and able to manage a circle; so we cut down the number to eight. I do not think the change was otherwise than beneficial.

2554. What was the exact function of each Superintendent?—Each Superintendent is regarded as the mouthpiece supervisors reports every day showing the arrivals and departures, the illnesses and the deaths in each block. There is an office in each circle and each Superintendent is in telephonic communication with the head office, and he communicates any details he think necessary to the Health Office.

2555. Is each block examined daily?—The theory of the scheme is that a census should be taken every day of the entire population; that has been done. For a month and a half we have accurate figures showing the departures and arrivals every day. But at first the supervisors found it practically impossible to get any information out of the people as was inevitable under the circumstances. Among 162 men of that sort there were a great many inexperienced ones, and they had no practice in this sort of work and could not induce the people to give them any information at all; so much so that their reports were practically worthless. It was not until we changed and got paid supervisors over whom we had some real hold that we succeeded in getting the supervisors to do their work.

2556. Were these arrangements in any way connected with the Health Department of the Municipality?—Unfortunately from the outset of the epidemic a great deal too much dependence was placed upon the Health Department of the Municipality, mainly with the idea of managing the business as economically as possible. But it was found that the Health Department broke down; the head of the Health Department was very dissatisfied and the strain was too great. I might mention that the state of things I have described was mainly brought about by extensive strikes which pervaded every department of the Municipality. The scavengers struck, or a large portion of them. They had carts which carried away the street sweepings every day, and came from the villages around the Civil and Military Station. On the pretence that the villagers would not allow them to come into the plague-infested area, they all struck work. Then the hospital establishments all struck work also; and the ambulance-service was thoroughly disorganised by defection and refusal to work except at exorbitant rates of pay.

2557. This Health Department had, I suppose, nothing to do with the visiting and the supervision?—No, except that the Health Officer was supposed to be the head over all the Superintendents and supervisors.

2558. The Health Department had to deal only with the sanitary condition?—Yes, the ordinary function of the Health Department would be merely the sanitary management of the station, but the Superintendents and the supervisors were all put under the Health Department to start with, with the results which I have described.

2559. The Health Department was not very efficient, I understand, from what you have said?—No, I am afraid it was not; it would, however, have done very much better had it not been so impeded by the strikes.

2560. Previously to the epidemic, what was the general condition of the conservancy of the city?—I think it left much to be desired; it is a matter which has been discussed very frequently here, and an officer who was here on special duty, Major Ross, I.M.S., has written a long report on the conservancy of the place. The Municipality has spent an enormous sum on the conservancy of the station, but I am inclined to believe with somewhat inadequate results.

2561. Have they improved the sanitation?—The sanitation is better than it was, but it is almost impossible to introduce any effective system of sanitation with the money which is likely to be available here in a place so congested as Bangalore is. Some of the divisions, like division No. 13, for instance, contain a population of 8,000 people; there is room perhaps for about 3,000.

2562. There is overcrowding?—Yes, there is overcrowding.

2563. Is there a good water-supply?—Within the last year or 18 months we have been brought by a temporary connection into the Darbar's water-supply, but we have really only had water from our own old supply for the last few months.

2564. Previous to the epidemic or since the epidemic?—Previous to the epidemic.

2565. It was already introduced?—Yes; all the pipes were not working before the epidemic, but a great deal of the water from the bazar was obtained through the pipes before the epidemic commenced at all.

2566. I suppose there is no practical attempt made to deal with sewerage?—No, there is a main sewer which runs through the bazar. It is all a system of open drains. A

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up I think the general idea is that they prefer to have a system of open drains unless they can insure very good supervision over the closed ones, and an adequate supply of water, of which there is some doubt.

2567. Has this public Health Department existed for many years in Bangalore?—No, it is a creation within the last three years.

2568. You can scarcely expect very much to be done within

2577. The contacts are allowed to remain in the same place?—Yes, if they have all been inoculated.

2578. But the house is not disinfected?—I may mention that there have probably been few cases in which this has been brought into practice, but the house would be disinfected, with the exception of the room in which the patient was lying.

2579. What interval do you think would generally elapse

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2588. You have been good enough to prepare certain statements for the Commission. You have given us, for example, a statement showing the census of the Civil and Military Station during November 1898 * and the attacks and deaths in each circle day after day in the Civil and Military Station,† and do you think it would be possible to supply us with a statement of the population in each of these several circles ?—Certainly.

2589. Because it is impossible to estimate the actual amount of mortality in any given circle unless we have that statement. It varies very much I observe ; in some circles there are 34 cases and in others as many as 270 ?—I can give it to you in a statement and work it out ‡

2590. Can you tell me if there is any relationship between the density of the population and the number of cases ?—In No. 13 Circle, which is perhaps the worst, the most over-crowded, and the dirtiest part, there were 244 seizures and 221 deaths.

2591. Is this Circle No. 8, to which I have referred, a very bad one ?—It is also a bad one ; it is one of the most insanitary parts ; I think it is as insanitary and as over-crowded as No. 13.

2592. So that, generally speaking, you think there is relationship between the two points ?—There is a direct connection ; until the plague becomes very severe there is a direct connection between the dirty and over-crowded parts of the town and the course of the plague.

2593. Now we come to the column headed " Unknown in City Limits " in your Statement B. Will you kindly explain that ?—These are cases which are found in the streets or on the verandahs or in the road, which cannot be traced to any particular circle. I had these cases taken out specially, because there was some doubt in going through the returns to which circle they belonged, and it would have been misleading to have left them in any circle, because they happened to be in the returns for that circle. The residence of the persons was not known, and it was not known where they came from and so they were put into this column.

2594. A very large number seems to fall under that category ?—Yes, 220 deaths. [Note by witness on correcting proof of his evidence :—It has since been found that in many of these cases the persons had died in houses, but the Plague Registrar when compiling the daily returns did not know to what circles these houses belonged.]

2595. Your Statement B† shows the number of seizures and deaths in September, October, and November. I think it would be useful if we could have here also a statement as to the number of Europeans, Muhammadans, and Hindus, if it is possible to obtain that ?—I put in a statement.§

2596. The Hindus appear to have suffered in the largest numbers, but of course that may not mean a larger percentage as they predominate greatly ?—I will give you the exact figures of the population by race and religion.‡ There is no doubt that in these very over-crowded circles, Nos. 13 and 14 especially, the Muhammadans have suffered very severely.

2597. At any rate you can give us the exact figures ?—The statement showing the seizures and deaths from plague, if judged merely by the figures, would be entirely misleading as regards the total deaths. I have put in the last column § on purpose to show the total mortality which is the only safe test. It shows the total mortality day by day, and how it has gone on increasing. If you deduct the daily mortality, you will arrive at some sort of estimate of the deaths from plague. I do not know that anything will be accurate.

2598. You say that the Muhammadans seem to have suffered very severely ?—I have not got the statement here, but I can supply one, if the Commission would like it, showing deaths from other causes, that is to say, the difference between the deaths from plague and the total daily mortality, and how many of these were Muhammadans.

2599. And how many were Europeans and how many Hindus, in fact the sub-divisions which you yourself have given ?—Certainly.‡

2600. Now with regard to the predominance of mortality in certain classes and nationalities, is there any relationship also in the social position of the several nationalities which would explain the difference to some extent ? Are the Europeans, for example, generally speaking, of different social position ?—The only European who has died of any position here was a Mr. James. I know the details of his case. He was in very well-to-do circumstances and lived in a bungalow on the parade ground. His house had been infested with dead rats and squirrels for some time. He took no notice of it, and I believe also he kept his premises in a very dirty state. He was attacked by plague and taken, owing to a mistake on the part of the Health Officer, to the Plague Hospital, instead of being segregated in his own house.

2601. With regard to the social position of the Muhammadans and the Hindus, are they very much the same ?—Yes, I should think so. There is no marked difference. Of course there were a great many poor Hindus and poor Muhammadans, but there were not men who were at all high in the social scale, so far as I knew, who have been attacked by plague.

2602. I suppose the condition of the habitations of those attacked among the Muhammadans is much the same as those of the Hindus ?—Yes, very much the same.

2603. You think therefore the fact of a man being Muhammadan or a Hindu has no effect upon the incidence of plague ?—I am unable to give any opinion about that.

2604. You gave us an account of the opposition of the people to many of your measures ; can you tell me if that attitude is improving ?—I believe it is, judging by the facts that we now get hold of many more plague cases and that the deaths from other causes have decreased considerably ; I think we can say that we get hold of a larger proportion of plague cases than we did. Still we do not get hold of the plague cases until most of the patients are dead. People so dread to go to the hospital that they do not give information till the patient is dead. Even now we frequently do not get any people to segregate. They wait until the death of the patient and then disappear and send intimation to the circle office.

2605. In addition to the measures you have described, you have used inoculation largely ?—Yes. On that point Captain Leumann can give full information.

2606. (*Mr. Hewett.*)—Have you had arrangements here for a long time to protect Bangalore from outside infection ?—Yes ; for several months before the plague commenced we had an inspection station at Harihar on the Railway.

2607. To protect Bangalore from the Bombay Presidency ?—Yes.

2608. Did many cases actually get into Bangalore ?—No.

2609. Your arrangements were successful ?—Yes, there were some doubtful cases at Harihar, under the Darbar management : but the only case we had before the 12th August was that of a man who had been up in the North. On bacteriological examination he was found to have the plague ; we had no one else.

2610. The Civil and Military Station and the city are practically one, so that we must look for the source of infection in the Bangalore City ?—Certainly.

2611. As recorded in your Statement B,† the number of attacks is 1,905, and the number of deaths is 1,527 ?—Yes.

2612. But you estimate there have been about 3,200 deaths ?—That number is almost more or less a fanciful estimate ; it depends entirely upon what the normal death-rate would be. The normal death rate for these months in the year is only about 6 per diem. The general idea is that the normal mortality in these days is 10 per diem, but the actual figures for these months, October, November and December, work out at a very much lower figure.

2613. That will raise the mortality still higher ?—Yes, at the same time the general idea is, it may be right or wrong, that the natural death-rate has been very high. I do not know whether there has been any justification for that.

2614. Has it been an unhealthy year generally ?—It has been a wet year. They say that a great many old people have died of debility.

2615. Does the epidemic show signs of decreasing at present ?—The epidemic may be described as stationary now. There was a slight decrease in the last two or three days, but whether that is due to an ordinary fluctuation in the epidemic or not I cannot say. I think we may reasonably hope that we have got to the height of it.

2616. Have you great difficulty in ascertaining whether deaths occur from plague or not ; have you tried the agency of native medical practitioners?—The idea was encouraged from the start, and it was announced that nobody need have recourse to any system of medicine unless he chose to do so, and we enlisted the services of some medical practitioners. I may mention that a certificate of death is required in every case, otherwise the assumption is at once raised that the patient has died of plague. People were allowed to produce certificates of certain recognised Vaids and Hakims whose names were registered in the Health Office. But it was soon found that these men were giving false certificates all round. On one day I remember the deaths from other causes were as high as 88.

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* See Statement A at the end of the witness' evidence.
† See Statement B at the end of witness' evidence.
‡ See the record of Mr. Cadell's re-examination on the 14th of March 1899.
§ See Statement C at the end of the witness' evidence.

2617. No cases of plague were certified?—Some cases were, but very few.

2618. The proportion is very small?—Yes.

2619. Had the 220 bodies that were discovered been thrown out into the roads?—They were found in the streets or in the fields, men who had been wandering about and had fallen down dead. It is almost impossible to say how they came there. [Note added by witness on correcting proof of his evidence:—Please see note to answer to question No. 2594. Most of these cases had, it was found, not been thrown out.]

2620. How many people have you now in the segregation camps?—I will produce a statement before the Commission containing figures for the segregation camps. At the present moment they are not quite ready.

2621. And showing the deaths from plague and deaths from natural causes in the segregation camps and also admissions to the Plague Hospitals?—(The following figures were subsequently supplied by the witness, *viz.*:—

(*a*) Admissions to segregation camps from commencement of epidemic to end of November 1898	1,076
(*b*) Deaths from plague among (*a*) . .	1
(*c*) Deaths from other causes among (*a*) .	7
(*d*) Admissions to Plague Hospitals from (*a*)	43)

2622. How many contacts have you had in your camps?—We could work it out of course by dividing the total admissions to the segregation camps by the number of cases, but that would be an absolutely fallacious test, because, as I have mentioned in my examination by the President, we found great difficulties in getting hold of any people to segregate. The fear of segregation and of our measures is such as to render the segregation measures practically useless.

2623. You think that you have secured an insignificant proportion of the actual contacts?—Yes.

2624. You have no private camps, have you?—We did our best to start private camps, and sites were allotted to the various communities. Subscriptions were raised and I interviewed the various sections of the community who promised and seemed eager to start their own camps where they knew they would be quite unrestricted, but nothing whatever has been done.

2625. The people have shown great fear of the plague here, have they not?—Yes, great fear; so much so that one of the most deplorable results of the epidemic perhaps is the absence of natural affection displayed in a great many cases. Mothers have refused to nurse their children and frequently people have left their sick relatives in a house and gone away.

2626. There has been a neglect by the people of the religious obligations to which they ordinarily attach so much importance?—In many instances, more so in the Peta, where there are more Brahmans.

2627. The people show no inclination to help themselves by starting private camps?—Not in the least. They show no inclination to help themselves or the authorities.

2628. Have they much objection to go into the Plague Hospital?—On that point I can only say that I visited the Plague Hospital very frequently and talked to the nurses and have seen men going there. I speak as a layman, but I should think that to send a man to the Plague Hospital if he is in an advanced stage of plague is the worst thing you could do. It has almost the effect of killing him right off. The nurses have told me that some of the patients arrive in an absolutely terrified condition. There were also foolish rumours here of the Government poisoning the people.

2629. Do you think the objection to being sent to hospital is attributable to the number of cases which die shortly after arrival at the hospital?—It may be so. A great many people think that when a man goes to the Plague Hospital he goes there to die. I think it is merely the compulsion which is objected to: because I may mention that in both the hospitals we have every facility for treatment by native methods. Whole families could go there if they liked and be accommodated in huts. In the only case which I know of where a high class family of Hindus went there, they left the patient and decamped.

2630. They did not take advantage of the rules which permit of relations going to the hospital?—Not at all; even in the cases where they do resort to these huts they have no objection whatever to, and in fact invite, the English style of treatment. Down here in the South of India, objections on the part of natives to the English style of treatment hardly exist.

2631. They do in some parts?—Undoubtedly.

2632. You have mentioned that soldiers went about with the parties; I understand they are absolutely without arms?—Yes.

2633. And were only used for the purpose of moral support?—Yes; there has been a great deal of prejudice; the public have been misinformed about the action of the soldiers. Before they were allowed to commence work detailed instructions were given, as to what the soldiers were to do, to the officer commanding, and copies were distributed to the non-commissioned officers. I have not heard of a single case in which there has been the slightest complaint made against the British soldiers, but on the contrary all the officers with whom they have worked testify to the excellence of their behaviour. There is not a single instance of any native woman having been molested by them.

2634. Have any complaints come to you from the people of this place as to the behaviour of the soldiery?—None whatever.

2635. Had there been any cause, you have no doubt you would have had complaints?—Not only that, but on the first day they worked I went with some of the parties through the bazar myself, because the people professed great fear of the entrance of the soldiers.

2636. Have the Muhammadans got themselves inoculated here?—They have recently; I think the recent change of policy here has had the effect of stimulating resort to inoculation, especially among the Muhammadans. Captain Leumann will give you the figures. There has certainly been a marked increase of inoculation among the Muhammadans.

2637. Does inoculation exempt a contact from going to the segregation camp?—Yes, it does under the orders of the Government of India. Before this change of policy, supposing a case of plague occurred in a house, the uninoculated patient would be sent to the Plague Hospital and any inmates of that house, if inoculated, would be required to clear out of that house. They could go anywhere and need not go in the segregation camp. But recently, in the case of the better class of houses, if the whole of the inmates including the patient are inoculated, they are not disturbed in the house until either the death or recovery of the patient.

2638. That inducement only appeals to the better classes?—Yes. I think the slight concession which is involved has had a very favourable effect in the minds of the people. Indeed the exodus of the people is almost stopped now. A certain number of people go out, but almost the same number of people return, so that the nett result is about stationary.

2639. At what figure do you estimate the total number of persons now present in the Civil and Military Station?—We find great difficulty in ascertaining exactly the number who have left, but estimating the population of the Civil and Military Station at 84,000—that is to say, the Civil population,—there were on 10th December 59,000 people left. To that must be added a percentage of 7, 8, or 10 increase since the last census was taken.

2640. A substantial number have left?—Yes.

2641. Has the great majority of those who have gone out obtained a pass or not?—No; we failed to control the movements of the people under the pass system, because our police force is very inadequate to guard all the roads, and a number of people went out at night across the fields.

2642. Would it not have been impossible to control the pass system without an enormous establishment?—Yes. The Mysore Darbar have been very good in putting the police pickets on the roads, but they have only been able to spare a certain number of men.

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2643. If you had a cordon of a large number of men, would it be effective?—I do not believe it would; I think people who could pay would be able to go out.

2644. The authorities have been keeping records here, have they not, with the view of seeing how many inoculated and uninoculated persons died of plague respectively?—I do not know that there has been any register prepared, but the information could be obtained in a day or two at the utmost by a reference to the returns.

2645. A record is made as to whether a person has died after inoculation or without inoculation?—Yes. I am not prepared to say that the information which the returns would give would be reliable; but the procedure is as follows:—If a man has died, the Municipal Officer makes an attempt to get an inoculation certificate. He is supposed under the orders to get the certificate and send it to the inoculating officer. If there is any doubt as to whether the man has been inoculated or not, he sends it to the Medical Officer who tries to trace it.

2646. But as a matter of fact is not this a matter of great difficulty?—Very great difficulty; I do not think the system is working well. I think if from the first the importance of obtaining the statistics had been more clearly recognized, we should be in a better position to supply correct information.

2647. Do you think that there is any inducement for people connected with the deceased to give up the certificate of inoculation?—No, I should think the tendency on the part of the deceased's relatives would be to stick to the certificate.

2648. Would these 220 bodies which have been found of people whose residence could not be ascertained be considered as uninoculated?—Yes; of course it is impossible to say whether they have been inoculated or not.

2649. Do you think you could give us the records of deaths distributed amongst (first) persons actually shown to be inoculated, (second) those actually proved to be uninoculated, and (third) the unascertained?—Yes. I will consult the officers working, and the District Magistrate, and I have no doubt we shall be able to devise some means of getting that information.

2650. This is probably the best place we could go to at present for getting any figures?—I certainly will do the best I can to get the figures. I recognise of course the great importance of them. Moreover, we have not up to the present time had thumb-marks, but I recognize that it is a desirable measure and it has been ordered. It will take some few days to carry out, because the officer will want some experience in the matter.*

2651. Has any great mortality among rats been noticed here?—The Municipality issued rewards for rats and they have killed many thousands of them.

2652. Has the outbreak of plague been associated with a great natural mortality of rats?—Yes; I have had some dead rats in the Residency.

2653. Were the rats found after the plague commenced or before?—After; I think we commenced killing rats before the plague got here. Very shortly after the plague commenced there was a lot of dead rats found, and the mortality among the squirrels was very noticeable. At the Cubbon Hotel, close to the Residency, the proprietor told me he had seen squirrels trying to jump from one branch to the other and falling down dead.

2654. Was that from plague?—Presumably. I do not know whether any of them were examined. I had the rats in the Residency examined and it was found that they had died of plague. The first rat which was found was burnt by the servants; the second I had bacteriologically examined and it was full of plague microbes, and I assumed after that that every other rat had died of plague.

2655. (*The President.*)—And the squirrels?—In a house close to the station where the Traffic Superintendent lived no end of squirrels died. Several were found dead inside the house. He sent them to be examined, but unfortunately the man took them to the wrong place and they were burnt. There is no doubt that the house was plague-infected, as the servants died.

2656. (*Mr. Cumine.*)—I think the plague in the City began amongst the coolies living near the railway station?—Yes.

2657. Was that the railway station at which Mr. Willans'

2658. Was the servant seen to be ill when he was at the railway station?—Yes; his master thought he was drunk; when he saw him he was staggering about and he accused him of being drunk which the man denied. They felt his pulse and found he had very high fever. As a matter of fact, his master, I believe, was going by an inspection train to Mysore, and finding the man was no use he told him to go home.

2659. Did the man lie down for some time at the station?—I do not know.

2660. Perhaps some of the station officials might know what became of the man?—Yes. I am almost sure that he went straight home. I think Dr. Benson would be able to give some detailed information about his movements; but I believe he went straight home. Anyhow he was ill in his house which was almost next door to the club.

2661. As regards the inoculated contacts, if the house is one of the better sort I believe they are allowed to remain in the house?—Yes.

2662. If it is not one of the better sort of houses, they are turned out?—Yes.

2663. Even then they are not compelled to go to the contact camp, are they?—If they are inoculated, they can go anywhere they like.

2664. That is the privilege which inoculated people get even though they may be living in a house of the worst class?—Yes. That privilege is one accorded them by the Government of India.

2665. There were, I think, restrictions on the exodus of the people at first?—There are still to the extent that if a man comes from an infected house, and they can find out that he has come from an infected house, they will not give him a pass.

2666. Probably about 25,000 people have gone?—Yes, about that.

2667. Do you know whether the restrictions pent them up for some time and then they went out with a sudden rush, or whether they went gradually?—I have handed in the returns showing the census of the Civil and Military Station during November,† which is the worst time. From the 1st November we have reliable figures. By the 1st November about 14,000 people had gone; this statement shows every day how many people went.

2668. (*The President.*)—Is this excluding the Military?—Yes, entirely excluding the Military.

2669. (*Mr. Cumine.*)—Do you know to what extent the surrounding villages have been infected?—I have not the detailed knowledge of it, but I am aware that they have been affected to a considerable extent.

2670. (*Prof. Wright.*)—Have orders for segregation of contacts and removal of the sick to hospital been continuously enforced since the beginning of the epidemic?—No, I think not. At one time, finding they were so unsatisfactory, we allowed the people in the contact camp to go out and earn their living on the advice of Major Deane and Colonel Dobson; and a great many of these people disappeared. It was found it did not answer, and involved some risk, although the officers themselves were very much in favour of it. That lasted for a few days, and then I re-introduced the order.

2671. During the time the regulations were suspended had you less concealment of plague cases? Did you find less bodies about the town?—I do not think it had any effect one way or the other. The only marked effect on the public demeanour was after the announcement of the change of policy with regard to the inoculated persons being allowed to be treated in their own houses.

2672. You are not able to judge whether segregation really caused the concealment of cases?—I am sure the measures made from the beginning induced people to conceal their cases, and I think there can hardly be any doubt that these have indirectly the effect of increasing the spread of the plague, because they induced people to scatter themselves all over the place where we could not find them.

2673. Do you think the regulations for compulsory segregation of contacts were abolished for a sufficient time to enable you to judge whether people would come in and report cases freely under those circumstances?—The reason we made the change was that we believed we were not getting half the plague cases under our cognizance, a very small proportion of the segregation cases. It is not pretended too valuable to be destroyed, but cannot be so soaked, such as books and papers, must be laid out in the sun as long as possible.

"(6) Sprinkle all articles of furniture with perchloride of mercury solution: then take them outside and there thoroughly swamp or drench them all over with the same, or dip them in a tub of it, giving particular attention to holes and crevices, and such parts as the cane seats of chairs or cots. Then leave them exposed to the sun as long as possible.

"(7) The room being empty, thoroughly spray every part of it with the perchloride of mercury solution with the pump beginning with the roof and working down all round, and giving particular attention to all corners and crevices.

"(8) Pick up mud floors to a depth of two inches, take the earth outside, make it into a heap with cowdung bratties or other combustible material, and burn it. The heap should be made of alternate layers of fuel and earth, with fuel over the top, sprinkled with kerosine oil, and then lighted at several parts at once; it should be kept burning till all the fuel is consumed, and all the remains should then be carted away.

"(9) Clean up thoroughly the whole of the surroundings of the house, sweep up all rubbish from the yard or cookhouse or latrine and burn it. Flush all drains and latrines with carbolic or phenyle solution, and sprinkle carbolic powder freely about.

"(10) The occupants of the houses or rooms on each side should be required at once to thoroughly clean up and whitewash them. Chloride of lime should be supplied to them to be mixed with the whitewash.

"(11) When the disinfection of a house is completed, the doors should be locked and sealed by the Special Plague Officer, and a red cross with the date painted on the outer door. No person is allowed to enter and re-occupy such a house without written sanction, or until it is re-opened for the purpose by the Special Plague Officer.

A. M. SLIGHT,

President, Municipal Commission."

"NOTE ON DISINFECTANTS TO BE USED.

"(1) Perchloride of mercury, or 'Corrosive Solution.'

"This is the best disinfectant for general purposes, and should always be the one chiefly used. It will be issued to the disinfecting parties from the Health Office in the form of a strong solution in bottles. The directions as to the amount of water to be used with each bottle will be written on the label of each bottle. It will usually be one bottle of the solution to six gallons of water, and for this purpose each wooden tub for use with pumps should have a distinct mark to show where six gallons come to. The solution is very poisonous, and must be used with care. It will be made of a slightly blue colour to prevent mistakes.

"(2) Carbolic acid, phenyle, Whalley's fluid, pineoline.

"These are all similar in their action. They will be supplied to the parties in bottles or tins.

"For flushing drains or disinfecting clothes or other articles, use about 4 oz. to a bucket of water.

"For bathing, or washing the hands and feet, use 2 oz. to a bucket of water. For this purpose phenyle, Whalley's fluid and pineoline are preferable to carbolic acid, as the latter does not dissolve easily.

"All persons employed in disinfecting work should wash their hands and feet well in such a solution after finishing the work.

"(3) Permanganate of Potassium.

"This will be supplied in solid form in powder or crystals. If there is a well on the premises to be disinfected, it should be disinfected with permanganate potassium, from one to two ounces being used for an ordinary small well. A solution of about half an ounce to a large bucket of water is useful for soaking such articles as brass vessels or cooking pots, for which perchloride of mercury must not be used. When this solution loses its blue colour and turns brown, it is useless. This solution must not be used along with carbolic acid or phenyle, etc., as they act opposite ways and would counteract each other."

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2708. (*Mr. Hewett.*)—Are the pass regulations under your control ?—No; I have had nothing to do with signing passes or making them out.

2709. Under the system by which the medical officers give the permit for burials, are these certificates signed after the religious rites have been carried out or before ?—It depends. In many cases they have laid the corpse out, and it has already been taken off before the report comes in; in a great number of cases the body is abandoned and they have done nothing at all.

2710. I mean in the case of those persons who take the corpse to the burying ground themselves, and have not deserted it, is it a rule that the medical officers inspect the corpse before or after the religious ceremony has been carried out ?—I do not think you can make any fixed rule. I think it depends upon the reports given.

2711. Have you heard of any objection to the examination of a dead body ?—The Muhammadans often make objection to your entering the house, and of course the Muhammadan females can only be examined by nurses.

2712. You have not heard any absolute objection to corpse inspection *per se* ?—No.

2713. Have you heard the questions which were put t Colonel Robertson with regard to the certificates of inoculation ?—No.

2714. Is it your opinion that when a person, who has received a certificate of inoculation, dies, his relatives will be willing to give up the certificate for nothing ?—It is very hard to say. I think it is quite possible that these certificates may be passed on.

2715. Would there be any inducement to retain the certificates ?—Undoubtedly.

2716. (*Dr. Ruffer.*)—The people were segregated and placed either in health camps, or contact camps, were they not ?—The segregation is the contact camp; the health camp is only for people who go and live there, because they have done their segregation or because their locality is unhealthy. It is absolutely open and they are not compelled to go there, or stay there.

2717. Could you give us the mortality in your segregation camp ?—I have no figures for that; that is entirely under Colonel Dobson.

2718. Have you any idea how much a contact costs pe day ? Have you got to feed him ?—Yes; that is und Colonel Dobson. The hospitals and camps with the exception of the health camp are entirely under him.

2719. The natives have strong objection to segregation, and you say they generally run away when anybody is dying or is about to die; do you think this is due to the fear of segregation only, or is it due to the fear of segregation combined with the fear of their clothes and personal effects being spoiled by the disinfection process ?—Yes, both; I think they object to disinfection very strongly and to segregation also.

2720. To what part of the disinfection do they most strongly object, to the disinfection of the houses or some of the household goods being burnt ?—They object to all of it very strongly. First of all it means that the house is closed up—for a short time now, but previously it was for a long time. A part of the roof is removed and all the floors dug up; and probably a part of their kit is burnt. Compensation is made, but still the articles are gone, and they consider they do not get full value for what is burnt. I think they have the strongest objection to disinfection.

2721. Do you think if the disinfection of their effects were completed in a couple of hours and the inhabitants were then permitted to return to their houses, they would still have a strong objection to the measure ?—Not when they come to understand it; they would probably object to it, but nothing like so much as they do now; but it would take them some time before they understand it.

2722. Do you think they would run away as they do now if no segregation measures were enforced ?—No; with segregation done away with and disinfection lasting only two hours, I think that would stop the greater part of it.

2723. You think they would not be so much inclined to run away ?—I think it would stop a greater part of the concealm

(Witness withdrew.)

MAJOR H. E. DEANE, R.A.M.C., called and examined.

Major Deane.

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2724. (*The President.*)—You belong to the Royal Army Medical Corps?—Yes.

2725. And what rank do you hold?—I am in charge of the Miller's Road (North Camp) Plague Hospital. I took charge on the 20th November; previously to that I had been doing duty in one of the districts for three or four days.

2726. (*Dr. Ruffer.*)—I think you have no evidence showing the origin of plague either here or in Bombay?—No.

2727. Could you give us some information as to the way in which plague is communicated?—From what I have been able to observe myself here and in Bombay, I have no idea on the subject except that infection can be conveyed in ways similar to all other infectious diseases. Though there may be one way more than another in which plague can be communicated, I think that method is yet to be determined. To illustrate what I mean, we know that typhoid fever is contagious chiefly through the excreta, but I think even in that case it has to be determined how it gains entrance into the body, whether by inhalation, swallowing, or through abrasions of the mucous membrane. I think in plague the only position we can assume at present is to suppose that the infection may be conveyed in all ways, and I do not think that there is yet sufficient evidence to show that it gains entrance into the human body more in one way than in another.

2728. Have you any evidence as to the entrance of the bacillus into the body by small wounds?—When I was in Bombay I had a hospital for some weeks. There the idea was mooted that the infection was conveyed through scratches or abrasions in the feet. As to the prevalence which I noticed here in this hospital, of femoral buboes, I have never been able to satisfy myself of any abrasion, or scratch or cut in the feet in such cases. The only case I have bearing on the point at all is one which occurred two or three days ago in the hospital here; an inoculated ward boy from Poona was reported as ill and he had a swelling in one thigh. I was informed that he had a boot-chafe, and he had a chafe presumably from a shoe over one tendon achillis. But the bubo was on the other side. He died within 24 hours. I think it is mere conjecture that the poison is conveyed through scratches. If there were scratches, I have been able to find no evidence of a scratch which may have existed showing any local signs, which presumably it would do. Then again we have to consider as against the view of the infection by means of scratches that the skin of the natives' feet is pachydermatous.

2729. When you examine the feet, do you find a large number of scratches?—You do. But if you look at them, you will find you get regular fissures through the heel, but that is only through the outer layer of the epidermis. Then again I have a man doing duty in the hospital with chafes on his toes. One would protect that man as much as possible, because there is the possibility of the disease being conveyed in that way. I think there is no evidence that it is. I have not been able to find in femoral bubo cases, either at Bombay or here, any evidence of abrasions of the soft part of the toes, or in-growing nails or anything of that sort.

2730. How do you explain the frequency of femoral buboes?—I have no theory. I should like to say this with regard to femoral buboes. The next most frequent place for buboes is the axilla. It struck me that that may possibly be owing to the extra vitality perhaps existing in those glands, owing to the movement of the arms and legs. The next most frequent are the cervical glands, which are subject to more movement than other lymphatic glands.

2731. Have you any evidence as to plague being carried by mosquitoes, fleas, or rats?—None.

2732. Or by the fæces or the urine of a plague patient?—None at all.

2733. Or by clothes?—The attendants in the hospital here who contracted plague may have done so through the clothes, but I cannot say.

2734. You have no specific facts bearing on that?—No.

2735. Or with regard to bodily exhalations?—No.

2736. You say in your printed précis of evidence that "The clothes brought to hospitals by patients, and which presumably should be infective to a high degree, do not spread infection; though in some cases it has not been practicable to destroy or even disinfect them." Can you give us the facts on which you base that statement?—That statement is on the observation of a small number of attendants in the hospital who did not contract plague even though they were handling the clothes. I myself have been obliged to handle patients who have come straight in out of the house in their dirty clothes; and other medical men have done the same, and no one has contracted plague.

2737. Can you tell us the number of ward attendants who have contracted plague in this hospital since the hospital was opened?—Four.

2738. What is the number of your attendants?—Six ward boys, and 10 ayahs concerned in the actual attendance on the sick. Only one has got plague since I have been there. The others I find from the hospital records. The one which occurred since I have been there had a bubo in the left femoral region.

2739. (*Prof. Wright.*)—May I ask how many were inoculated?—They were all inoculated. I have not the actual documentary proof; but all the ward boys who came from Poona were reported to be inoculated.

2740. (*Mr. Hewett.*)—Do you know how long ago that was?—They were inoculated about eight months ago, but exact dates are not procurable here.

2741. (*Prof. Wright.*)—Then you had four cases?—There were four among the attendants who contracted plague. They all died. They were all inoculated.

2742. Do you take that to be not a severe mortality among the inoculated people?—I would not like to give an opinion.

2743. (*Dr. Ruffer.*)—Then your argument that because the attendants in the hospital do not get plague to a larger degree, would be an argument against every form of infection, not only against infection by clothes, but also against every possible mode of infection?—I think it is, provided the contact takes place in sunlight and air.

2744. Then it is not a special argument against the infection being carried by clothes?—No. When I read over my précis again in print, I think it should have been worded differently. I did not mean to make a special point with regard to infection by clothes. What I meant was that the presumption of infection by clothes was not stronger than the presumption of infection in other ways. That is all I mean by that.

2745. You have had some opportunity of watching the cases treated by Yersin's serum in Bombay, I believe?—When I was in Bombay I went round the hospital there and took notes from the records.

2746. Did you observe them yourself or simply take notes?—I kept the records and there were some cases that I actually saw. There were ony a few cases which were still alive when I got to Bombay.

2747. Will you kindly confine yourself to the cases which you actually observed? Did you notice any effect, either good or bad, from the treatment by Yersin's serum?—I observed no good effect; and in one case it was a question—although I should not like to say it was so—as to whether it did not accelerate the symptoms. But as it was an exceedingly acute case, it is hard to say.

2748. Did you notice any effect on the temperature produced by inoculation?—None at all.

2749. Or any effect on the buboes?—No.

2750. You noticed no effect after the injection?—Except that it seemed to hasten the suppuration of the bubo, but I do not place much reliance on that.

2751. How many cases did you see actually yourself?—Three; they were the last that were done in Bombay. It was stopped after that.

2752. I believe you have some evidence to give as to the particular mode of treatment which has been used here?—I have only the evidence I gained from experience in Bombay and the experience here. But it is in an undeveloped state yet. We are not far enough advanced to give that evidence.

2753. Have you had any personal experience of segregation?—I have only had general experience, being on plague duty as a District Medical Officer in Bombay and seeing segregation carried out.

2754. Confine your evidence to the segregation which you have actually performed; can you tell us whether it has any drawbacks or advantages?—I think you get fewer cases in a family which is segregated when the patient goes to hospital than if they were allowed to remain in their own houses; but I have not the actual figures with me. The

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actual number of cases is on record in the evidence, which I sent to Colonel Dobson, of the cases which came from the contact camp, which are comparatively few.

2755. With regard to inoculation with Haffkine's prophylactic fluid, have you any experience or not as to that ?—I have not performed it myself.

2756. Have you seen any patient after the inoculation ?—Yes.

2757. Immediately after inoculation, I mean ?—Yes.

2758. Can you tell us what the symptoms are ?—General febrile symptoms, malaise, and high temperature; almost the first symptom is a severe pain and tenderness in the arms. The general symptoms are those of malaise, and a septicæmic condition.

2759. Any serious symptoms ?—I have not seen any serious symptoms myself.

2760. Have you ever seen cases of plague following soon after the inoculation with Haffkine's prophylactic fluid ?—Yes, I have one in the hospital at the present time.

2761. Can you give us the details of this case ?—It was inoculated twice; the first time three months before admission. It came under my care two days after the second inoculation. The case runs chiefly a nervous course.

2762. Where was he inoculated ?—I believe in the left arm. He had exceedingly severe delirious symptoms. In fact for four or five days he was maniacal; he did not sleep and he had to be tied in bed. He maintained his strength and it was rather difficult to keep his bandages on, and the nurses had great difficulty, I believe, in confining him to bed. He developed a typical bubonic plague bubo in the right femoral region. The maniacal symptoms gradually subsided and he is convalescing; but he is still suffering from febrile symptoms.

2763. He had no bubo in the left axilla ?—He had no bubo anywhere, except in the right femoral. Another case I saw was a follower in the Horse Artillery Battery. I saw him one morning about half past eight. He had been inoculated the day before in the left arm. When I arrived the man was dead. The story I heard was, this is only hearsay as I did not see it myself, that vomiting set in ten minutes after the inoculation, which vomiting never ceased. I examined the body for bubo and there was none, and there was nothing noticeable at the seat of inoculation.

2764. Were there any enlarged glands ?—No.

2765. There was no evidence that the man died from plague at all ?—There was no evidence that the man had died from plague.

2766. Nor from the effects of inoculation ?—No.

2767. There was no *post-mortem* examination ?—I believe not. I did not make one.

2768. Do you know who saw that case besides yourself ?—I do not think any medical man saw him in his life-time. He was seen by another plague officer afterwards, I think by Mr. Clements, who may have found out further details about the case.

2769. Have you had any patients in the hospital suffering from plague after having been inoculated once or twice by Haffkine's prophylactic fluid ?—Yesterday I had 28 cases which had been inoculated.

2770. Can you give us the total number of people in the hospital who have been inoculated ?—I am afraid I cannot do that.

2771. Since you have been in the hospital ?—I could not tell you the numbers without referring; I think there have been between 40 and 50 since I have been in the hospital who have been admitted after inoculation.

2772. How long have you been in the hospital ?—Since the 20th November.

2773. Some of these patients were already in the hospital —Yes; some of them were there when I took it over. I went round to each patient and ascertained that. The exact number I cannot state without referring.

2774. Have you noticed any difference in the clinical course of the disease between the inoculated and the uninoculated ?—Not at all.

2775. Is the mortality higher or lower in the inoculated ?—I could not give any evidence worth anything upon that. I have only been there a short time.

2776. Have you any personal experiences showing the prophylactic effect of Haffkine's fluid ?—One case comes to my mind of a sweeper at the station hospital here, who contracted plague and was sent to the hospital. The other members of his family, all of whom were sweepers, employed in the neighbourhood—I employed one myself—had all been inoculated, and none of them at that time had contracted plague. This man was the only one in his house who had not been inoculated. This is the one instance I know of personally; but of course one has heard of others.

2777. Have you any personal knowledge as to how the figures bearing on inoculation have been obtained, whether the figures which have been given by various observers are accurate or not ?—I have seen them in the papers, and have a general knowledge.

2778. But you have not personal knowledge ?—I have no personal knowledge of how they have been obtained.

2779. (*Mr. Cumine.*)—Supposing a man gets infected in his waist, where would the bubo probably appear ?—I have no idea. I think it is a pure matter of conjecture; it depends on the man.

2780. As a fact have not natives very often got Indian ringworm, or itch or some irritating skin disease on their waist ?—Anything that I might say upon that would not be worth much, because being in the British Service I have not seen much of the general diseases among the natives. Colonel Dobson would be able to give much more evidence upon that.

2781. Your experience has been chiefly in the hospital ?—Yes, here. In Bombay I had a hospital and was working in the district under the Plague Committee.

2782. How long were you working in the district ?—I was three months and a half in Bombay.

2783. Were you visiting the natives in their houses ?—Yes; for the first six weeks or two months it was compulsory segregation, sending patients to hospital.

2784. You have said something as to the extent to which the disease has spread under the conditions of light and air which have obtained in the hospital. Did any facts come under your notice in Bombay in visiting the native houses to show to what extent plague has spread when there is hardly any light and air ?—Undoubtedly. In the district it was very striking to see the number of cases which occurred and kept occurring after the people next door had been cleared out, the number of cases which occurred in dark ill-ventilated places. In many of the rooms where we found the cases, and where the cases were most prevalent, we had to light a lamp to see where we were going. There was not the same number of cases occurring in the upper stories of the large chawls there.

2785. Did any facts come under your notice to show how it had got from one house to another ?—I have no idea.

2786. You have no evidence as to whether it was carried by human beings or otherwise ?—I have no evidence.

2787. Did you notice whether the disease among rats preceded the disease among human beings in a house ?—Not personally; I only have general knowledge with regard to the connection of rats with plague.

2788. (*Prof. Wright.*)—Have you seen any infection from pneumonic cases ? You spoke about four cases having occurred in the hospital, of which one came under your own observation ?—Yes.

2789. Have you seen any other cases in Bombay of infection in hospital ?—No, not in the one I had charge of. There was no case of the attendants' or of the patient's relations.

2790. Was the case you saw attending upon a pneumonic case ?—Not particularly; because we cannot keep them separately; there were pneumonic cases in the ward in which he worked, but he was not particularly attending on pneumonic cases; in fact less upon those than upon some of the bubonic cases, which were suppurating and required dressing. The pneumonic cases in his particular ward were mostly convalescent.

2791. (*The President.*)—Is it your opinion that infection may enter from every possible channel in the body, numerous channels ?—My opinion is that it may enter in any way in which infectious diseases may enter, either through the lungs, or inhalation, or swallowing, or through the skin.

2792. That has not been under your observation ?—No.

2793. It is merely a conjecture ?—Yes.

2794. You have not searched for the bacillus in any locality ?—No.

Major Deane.

12th Dec. 1898.

2795. Do you know where the buboes generally occur?—In the cases I have in hospital now the buboes are in the femoral region, right and left indiscriminately.

2796. You do not associate that with any entrance of the infection?—I have been unable to do so.

2797. You cannot think of any possible connection?—No.

2798. You told us that four of the attendants in the hospital had acquired plague?—Yes.

2799. That was out of a total of how many attendants?—40.

2800. The attendants were frequently changing, I suppose?—They were, I believe, but since I have had charge they have not been.

2801. What was your official connection with the plague in Bombay?—I was working under the Special Plague Committee and I had charge of a district in which there was a hospital. I supervised; I practically treated the cases myself.

2802. (*Dr. Ruffer.*)—With regard to the number of attendants, I suppose a certain number have been dismissed or have gone away for other reasons?—Yes; but there have been less than 16 on duty at one time.

2803. But they have not always been the same people?—No, to what extent they have been changed I cannot say.

2804. Can you tell us whether those who have gone away have contracted the plague since?—I do not know; information cannot be got.

(Witness withdrew.)

COLONEL T. J. MCGANN, I.M.S., called and examined.

Colonel McGann.

12th Dec. 1898.

2805. (*The President.*)—You are the Principal Medical Officer in Bangalore and the Southern Districts?—Yes.

2806. And I suppose that in connection with that office you have the direction of the plague operations in connection with troops?—Yes.

2807. Would you first tell us what is the number of the native troops in Bangalore?—A little over 2,800.

2808. And what is the number of the native followers and their families?—Nearly 6,000.

2809. You have had a good deal of plague among these people?—Yes.

2810. Have you been able to trace the origin of the plague?—The first case of plague which occurred was in the Regimental Bazar of the 2nd Madras Lancers. The disease was introduced there by a boy who came in from Mysore. He was said to have been infected with plague.

2811. Was he suffering from plague?—He died from plague in the Regimental Bazar of the 2nd Madras Lancers. The other occupants of the house consisted of two women who disappeared. I believe one died, and the other was not traced.

2812. How did it extend to the troops themselves?—There is a village close by which was much infected with plague too, and I assume it was from contact with those people, as there was intercourse between them and the lines of the regiment.

2813. There is no definite instance, is there?—No.

2814. Did it extend rapidly among the soldiers?—Not rapidly.

2815. Have you a statement which shows the extension from time to time?—No. I have only the deaths.

2816. The total deaths up to date?—Yes.

2817. But not of the progress of the epidemic?—No.

2818. What measures did you adopt when the plague came within your district?—We carried out the disinfection, evacuation and unroofing of all the houses in which cases occurred, the removal of the occupants of houses to segregation huts, and the inoculating of all the men in the regiment and their families as fast as possible.

2819. Did you have any difficulty with regard to inoculation?—There was a little difficulty at first among the Muhammadan portion of the native troops, but after a time that practically disappeared. The British Officers were inoculated before the men, and that encouraged the men to follow their example. In the case of the 2nd Madras Lancers those who were wavering and rather objected to inoculation at first were hastened on by the occurrence of a few deaths in their lines. After that we had not much trouble. At the present time we are re-inoculating, and have not much trouble.

2820. You have succeeded in inoculating all the soldiers?—Yes, with their families and followers; I mean the native soldiers, not the Europeans.

2821. (*Dr. Ruffer.*)—Did you do the inoculation yourself?—No, not personally.

2822. (*The President.*)—What about the European soldiers?—They have escaped up to this with the exception of one case which is reported to me to-day of a man in the 25th Field Battery of Artillery; that is the first case among the European soldiers.

2823. Has the idea not been entertained of inoculating British soldiers as a precautionary measure?—I have thought about it, but it was not considered necessary. It had not been done elsewhere and we did not consider it necessary here.

2824. But now that you have a case, what do you suppose will be done if the plague extends further?—I think we should probably inoculate if it spreads much amongst the men, if the removal of the patients and camping out are not sufficient.

2825. Do you think the latter measure is more effective than inoculation?—Personally I believe in inoculation very much, and so far as my personal opinion in the matter goes, I have inoculated every European who is exposed to any risk of contagion.

2826. You desire to carry it out whenever it is possible to do so?—Yes.

2827. Have you any difficulty in obtaining the inoculating fluid?—We had at first. M. Haffkine had rather a short supply at first; a certain quantity which was sent down to us miscarried, and there was some delay in getting another supply. In that way we were a little slow in the beginning.

2828. Have the British soldiers in the bazar been inoculated?—Yes, the disinfecting party.

2829. But not the others?—No.

2830. Have you observed any bad effects from inoculation?—I have heard of some.

2831. I mean have any come under your personal observation?—I have only seen a few cases of abscesses in the arms, a very few.

2832. Have you any figures which show the prophylactic effect of inoculation?—The statements which I give here are to my mind very conclusive as to its protective value.

Statement showing the percentage to strength of deaths from plague of both inoculated and uninoculated among the followers and families of the Hussars and Artillery.

Corps.	Strength.	NO. OF DEATHS SINCE FIRST APPEARANCE OF PLAGUE TO 10-12-98.			PERCENTAGE TO STRENGTH OF	
		Among inoculated.	Among non-inoculated.	Total.	Both inoculated and non-inoculated.	Inoculated.
4th Queen's Own Hussars	896	12	26	38	4·241	1·34
J. Battery, Royal Horse Artillery	471	3	1	4	·849	·636
21st Field Battery, Royal Atillery	550	5	2	7	1·272	·909
25th Field Battery, Royal Artillery	349	9	4	13	3·724	2·578
	2,266	Average for above corps			2·73	1·27

Statement showing the percentage to strength of deaths from plague of both inoculated and uninoculated among the Native Regiments at Bangalore.

Corps.	Strength.	No. of deaths since first appearance of plague to 10-12-98.			Percentage to strength of	
		Among persons inoculated.	Among persons non-inoculated.	Total.	Both inoculated and non-inoculated.	Inoculated.
2nd Madras Lancers	550	7	2	9	1·636	1·27
Queen's Own Sappers and Miners	784	3	2	5	·637	·38
1st Madras Pioneers	751	1	1	2	·266	·13
17th Regiment, Madras Infantry	725	5	2	7	·965	·268
	2,810	Average for 4 Regiments			·818	·569

Statement showing the percentage to strength of deaths from plague of both inoculated and uninoculated among the families of the Native Regiments at Bangalore.

Corps.	Strength.	No. of deaths since first appearance of plague to 10-12-98.			Percentage to strength of	
		Among inoculated.	Among non-inoculated.	Total.	Both inoculated and non-inoculated.	Inoculated.
2nd Madras Lancers	186	...	...	...	...	...
Queen's Own Sappers and Miners	1,247	2	3	5	·401	·160
1st Madras Pioneers	802	...	...	...	...	...
17th Regiment, Madras Infantry	965	2	...	2	·207	·207
	3,200	Average for the above			·218	·125

Statement showing the percentage to strength of deaths from plague of both inoculated and uninoculated among the Commissariat and Transport followers at Bangalore.

Corps.	Strength.	No. of deaths since first appearance of plague to 10-12-98.			Percentage to strength of	
		Among inoculated.	Among non-inoculated.	Total.	Both inoculated and non-inoculated.	Inoculated.
Commissariat and Transport followers	1,113	...	2	2	·179	...

Statement showing the date of commencing and finishing primary inoculation of different Corps at Bangalore.

	Date of commencing the primary inoculation.	Date of finishing the primary inoculation.
Corps.		
Queen's Own Sappers and Miners	12-10-98	7-12-98
2nd Madras Lancers	13-10-98	23-11-98
1st Madras Pioneers	17-10-98	3-12-98
17th Regiment, Madras Infantry	11-10-98	26-11-98
Followers and Families.		
4th Queen's Own Hussars	31-10-98	22-11-98
J. Battery, Royal Horse Artillery	31-10-98	31-10-98
21st Field Battery, Royal Artillery	25-10-98	9-11-98
25th Field Battery, Royal Artillery	25-10-98	22-11-98
Commissariat and Transport	21-10-98	22-11-98

Colonel McGann.

12th Dec. 1898.

Some of those which are classed as inoculated here died within 1, 2, 3, 4, or perhaps more days after inoculation; from that I conclude that they had the disease in them at the time of inoculation.

2833. What do you consider is the period of incubation?—It is commonly regarded as 10 days, which I think a liberal allowance.

2834. But it may occur within a much shorter period than that?—I think it is much more probable that it will occur in a shorter period than 10 days.

2835. Did you have many deaths among the camp followers who were inoculated?—Yes, we have had a good many deaths amongst the followers of the British troops and their families.

2836. Among the inoculated?—Among the inoculated also. The statement shows that amongst the inoculated and the uninoculated the percentage of mortality to strength has been 2·73 and the percentage of mortality to strength amongst the inoculated has been 1·27.

2837. Your case mortality on the whole has been very small?—Yes.

2838. To what do you attribute that?—I attribute it to the protective power of inoculation in the first instance, combined with the cleansing of houses and disinfection of clothes and personal effects as much as possible, which is not very easy amongst these people.

2839. Besides the value of inoculation, is there any other measure which you have adopted which is likewise conducive to the result?—We have moved the followers of the 4th Hussars and their families out into camps. We were unable to stay the progress of the disease amongst them even though they had all been inoculated, and they were moved from their lines out into gipsy shelters, grass huts, and huts of matting; and since their removal there has not been a single case among them.

2840. Were there cases before they were removed?—There were cases occurring here and there throughout the lines.

2841. They were inoculated?—They were practically all inoculated.

2842. After they were removed, the same people had no cases among them?—That is so.

2843. I suppose you infer from that that the removal into the camp is also a very valuable measure?—Yes.

2844. Did you do anything else besides removing them into camps?—Previous to their removal all their clothing and effects and everything were disinfected, and all communication between the camps in which they were lodged and the infected places was stopped.

2845. How did you effect that?—There were sentries placed round, and bazars were provided for them where they could purchase what they wanted.

2846. You were therefore able to do much more than the people in an ordinary community to combine those steps, each of which you think valuable?—Yes.

2847. And the result was extremely good?—Yes.

2848. (*Mr. Hewett.*)—You have not only the sentries, but these people are naturally liable to discipline, and understand it, do they not?—As a matter of fact there are no military sentries over them; they have their own people.

2849. You have no difficulty in getting them into camp?—No.

2850. Are the registrations of deaths practically accurate?—Yes.

2851. You did not get cases of families running away?—Some have run away, but very few.

2852. Not to the same extent as in the ordinary Civil population?—No, because the bread-winners of these people are employed as syces and in other ways in connection with the British troops.

2853. And every death must come to your notice?—Yes, there is a medical subordinate who inspects the cases every day, and also a medical officer.

2854. (*Mr. Cumine.*)—You gave us the facts about two sets of people: native troops and camp followers; taking the native troops first I understood you to say there were evacuations; are the whole of the lines evacuated?—The natives have their families in the lines along with them; a certain portion of them; but the followers I alluded to belong to the British troops here, and also the Commissariat and Transport Departments.

2855. You gave us percentages relating to the Native troops. Were they and their families totally turned out?—No, they were not turned out at all, except from infected houses and the next houses on either side; on the occurrence of a case three houses were vacated.

2856. What was the date of the first infection among the Native troops in their lines?—I am afraid I cannot remember the date.

2857. Could you give us the figures to show the comparative rate at which cases went on and inoculation went on, that we may see whether the epidemic appeared to be dying out amongst the Native soldiers before the inoculation took place?—No, I think it was then further advancing.

2858. Could you give us the number of attacks amongst the inoculated and the uninoculated among the Native troops?—I will get the figures for you.*

2959. Was there total evacuation amongst the camp followers in whom the percentage was 2·73 and 1·27?—These percentages refer to the followers and families of four corps, that is, the 4th Queen's Hussars, J Battery, R.H.A., 21st Field Battery, and the 25th Field Battery, R.A. These persons who were removed in camp were the followers of the 4th Hussars, not the others.

2860. The others were not totally evacuated?—Not at the time these figures were made out.

2861. Were they totally turned out eventually?—Yes.

2862. Had they all been inoculated before they were moved?—Practically.

3863. Could you give us as regards the camp followers the exact number of attacks before evacuation and after evacuation?—I will get that figure for you.*

2864. With regard to the segregated families of the Native soldier patients and of the houses on either side, could you give us the percentage of attacks amongst them to show what the advantage of segregation is?—They were all moved to the same camp.

2865. And also the number of attacks which occurred among the camp follower segregated contacts?—Amongst this particular community, that is, the followers or families of the 4th Hussars, there was very little segregation.

2866. But amongst the Native troops I think there was some segregation?—Yes, but only to a small extent.

2867. The complaint generally is in towns that you cannot catch the contacts. But among military people like these you do catch them. This is why it would be so useful to find out what number of attacks occurred amongst these military or semi-military contacts.—Speaking from memory, I think the number segregated was very small, and there was not more than one case of plague which occurred among those segregated.

2868. Could you tell us with regard to each inoculated person attacked how many days after the inoculation the plague appeared in him; do you keep any memorandum of that sort?—I can get the information for you, but I cannot speak from memory. It varied; some died the day after inoculation, some 2, some 3, some 4, up to 10 days.*

2869. (*The President.*)—Will you give us the number of days after inoculation that each inoculated person was attacked, and also figures showing whether you obtained any advantage in cases where you both inoculated and evacuated, over cases in which you inoculated but did not evacuate, particularising in each case how many deaths occurred within 10 days?—The figures asked for cannot be supplied.

(Witness withdrew.)

(Adjourned till to-morrow.)

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* See statements put in by Mr. Cadell in his re-examination on 14th March 1899.

At The Mayo Hall, Bangalore.

ELEVENTH DAY.

Tuesday, December 13th, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

LIEUTENANT-COLONEL A. F. DOBSON, I.M.S., called and examined.

Lieut.-Colonel Dobson.

13th Dec. 1898.

2870. (*The President.*)—You are the Residency Surgeon at Bangalore?—I am.

2871. You have had much experience of the measures which have been adopted in connection with plague?—Yes.

2872. (*Prof. Wright.*)—Did you have the chief superintendence of the disinfection arrangements?—No.

2873. We heard yesterday from Captain Roe that the disinfectants which he used were those prescribed by you; is that so?—Yes, as far as the disinfectants go.

2874. Captain Roe told us that you advised that each disinfecting gang should carry two different antiseptics with them, is that so?—I have not done so, so far as I can remember.

2875. Captain Roe told us further that there were three or four different antiseptics in use; will you specify what antiseptics were actually advised by you to be used?—Perchloride of mercury, carbolic acid, and permanganate of potash.

2876. In addition to that he spoke of phenyle?—Yes.

2877. And also we heard of an antiseptic called pineoline?—Yes; I did not specially recommend that.

2878. I understand pineoline was used and Captain Roe said he used it on your recommendation. Do you know whether it is or is not used?—I only know of its being used in one of the hospitals, in the South Camp Hospital, as a deodorizer.

2879. Then you did not draw up any list of antiseptics to be used and the strengths; are we to go to some one else for this?—Yes, I sent those to the Magistrate some time before the plague made its appearance in Bangalore.

2880. Do you remember what strength of perchloride of mercury you prescribed?—I prescribed it in two strengths, 1 in 1,000 and 1 in 2,000.

2881. Can you tell me how those antiseptics were to be made up?—The perchloride of mercury was made up with common salt; I think that was the best way.

2882. Was it to be made in a central station?—Yes.

2883. Do you remember what strength solution you instructed to be made up there?—The strength was given in the instructions which were issued by me, under my signature, but having noticed that my signature was removed and that the Magistrate attached his signature thereto, I took it for granted that he had the entire working of the disinfectants.

2884. As a matter of fact you did not hold yourself responsible for the antiseptics which are used?—I did not.

2885. You thought you were going to undertake that and afterwards as a matter of fact some one else undertook it?—Yes.

2886. You have seen a great deal of the effects of Haffkine's fluid, have not you?—Yes.

2887. I presume no definite statistics are here available as to the incidence of plague among the inoculated and uninoculated?—There are some, but I am afraid they are not very definite.

2888. Do you know of any cases of plague having occurred among the inoculated?—Yes.

2889. Major Deane told us he had a considerable number of cases in his hospital among the inoculated patients?—I am aware of that.

2890. Do you think the large proportion of cases found among the inoculated is due to the fact that they survive and consequently are brought to the hospital, whereas the non-inoculated die before they can be brought there?—I do not think so.

2891. You think the cases among the inoculated and uninoculated in the hospital fairly accurately represent what takes place in the town?—I think so.

2892. Have you noticed that plague runs a milder course in the inoculated than among the uninoculated?—Yes, it does.

2993. Have you seen any cases of pneumonic plague occurring among the inoculated people?—I have not.

2894. Have you any facts which bear upon the infectivity of clothing?—I have. I might give an example with regard to the infective nature of clothing. Some little time ago I observed that in the Civil Hospital here, which I superintend, some cases were reported as fever; and having my suspicion aroused I inquired into the matter and found that three cases of actual plague had occurred among the sick in the Civil Hospital. I thought the most prompt measures should be taken with a view to stop its further spread, and I took immediate measures for the complete evacuation of the main building of the hospital. Before transferring the patients to the buildings which were available for such purposes, I had the patients divested of their clothing, in fact everything was dropped in the wards; they were bathed and fresh clothing given to them, and they were transferred to the buildings which had been thoroughly disinfected under my own supervision. From that day up to the present not a single case has occurred except the one case which had plague in that hospital at the time, who had it already in the system.

2895. How does this bear on the infectivity of the clothing? Did you notice the clothing they left behind giving plague to anybody else?—No, I did not give the clothes a chance of communicating plague.

2896. You mean that you can stamp plague out of the ward by disinfecting the people and giving them new clothes and moving them into new places. But what I was anxious to elicit was whether you have any cases in which you have seen infection has been communicated by means of clothes irrespective of human contact?—I do not think I can say absolutely that that has come to my notice.

2897. What is done with the people who go into the Plague Hospital accompanying the sick; for instance, when a woman goes in with children, what precautions are taken against those children taking the plague?—Nothing very much is done to the patient; she is so ill generally that she is at once taken to the ward and put to bed, sometimes in her clothing, if it is not very filthy.

2898. The plague patients bring people with them who have not been infected with the disease?—Yes.

2899. These people are allowed to move about freely in the plague hospital?—Yes.

2900. Are these people inoculated so as to protect them from possible infection?—Not always.

Lieut.-Colonel Dobson.

13th Dec. 1898.

2901. Have you any observation wards in the hospitals? I suppose some doubtful cases are sent in from the town as plague cases?—Yes.

2902. Are they re-examined in the hospital to see if they have plague or not?—Yes, they are very carefully examined and where there is the slightest suspicion of a case not being plague, that case is put apart from the sick.

2903. There is a special observation ward?—Yes.

2904. Do you find many cases sent into the hospital which are not cases of plague?—No. I have not found more than a few.

2905. Is it your impression that the people suffer a great deal from being brought to the hospital; that their condition is made worse by their being carried to hospital?—So I hear.

2906. Have you seen any bad results following from Haffkine's inoculation?—I have not seen any bad results, and I think I have seen enough inoculations.

2907. Have you seen cases of plague recurring in a house after disinfection? Perhaps that is not directly under your observation?—No; it has been reported to me that cases have so recurred.

2908. Is there any other subject on which you would like to give information?—I have a written report of the hospital.

2909. Will you tell us the main points in it?—It states what had happened from the opening of the hospital up to date with regard to the number of admissions, the mortality, the recoveries, the classes of people affected by plague and the mortality, the persons in the contact camp who have been attacked by plague, the members of the staff who have been attacked by plague, the varieties of the disease and the position of the buboes.

2910. (*The President.*)—Will you read that report as you have it there?—This is the report of the North Plague Camp:—

"North Plague Camp.

"This camp was opened on the 15th September 1898, and consists of two small and four large masonry wards, seven matted wards and six Gosha huts with corrugated iron roofing: the whole capable of accommodating one hundred and eighty cases. In addition, there is a bungalow which is being utilized as a temporary hospital for European and Eurasian patients of both sexes and contains 10 beds. The camp is supplied with water from stand-pipes. The conservancy is arranged for by the incineration of all solid excreta and the removal by cart of liquid filth and washings."

2911. Do you mean urine is removed in carts?—Yes.

2912. Is it disinfected before it is removed?—Yes.

2913. How is it disinfected?—With antiseptics. "During the period, about three months, 686 patients were admitted, 101 recovered, 431 died, remaining under treatment 154: mortality 62 per cent.; and excluding cases which died within 48 hours of admission the percentage was 27; the number being 244.

"The deaths according to caste and sex are as follows:—

Muhammadans 24 males and 21 females.
Hindus 105 „ „ 62 „
Pariahs, etc., 219
Total 431.

"From the contact camp 29 cases were admitted out of a total number of 924 persons, and of the hospital menial establishment three were attacked, two of whom had been inoculated, and all died. Thirty-eight inoculated people were admitted with 10 deaths."

2914. (*Prof. Wright.*)—Is this the camp under Major Deane?—Yes.

2915. He said yesterday there were about four cases?—I have that letter; this was written before I got further information on the point. "Thirty-eight inoculated people were admitted with 10 deaths." I might in this connection add that the first cases which were admitted for plague and which had been inoculated, both recovered. Both, I am glad to say, were inoculated by myself.

2916. You had 38 inoculated patients and 10 of them died?—Yes. I think it is remarkable that the first two cases which were inoculated both recovered, as showing that the disease was distinctly affected by the inoculation.

2917. They had been inoculated beforehand, you mean?—Yes.

2918. Then we have to compare the mortality of 10 per cent. with the mortality of 62 per cent. among the uninoculated?—Yes. "Of the patients at present under treatment presenting buboes in each, the position is as follows:—

Femoral right	15,	Groin right	7
„ left	15,	„ left	12
Axilla right	8,	Cervical right (including sub-maxillary)	8
„ left	12,		
Both parotids	1	„ left	2

"The forms of disease noticed to be the most fatal are all septicæmic and all primary plague pneumonias."

2919. How is a septicæmic case diagnosed to be plague? It is a case without any buboes, is it not?—Yes, a case where there is great infiltration beneath the tissues I should take it, with prurient matter.

2920. What you mean is that a septicæmic case is one where you have local signs?—Yes.

2921. One which has local signs but which has general symptoms combined with it?—Yes. "No special treatment by drugs appears to do much, but if cases are received early in the disease, *i.e.*, within one or two days of its appearance, good diet, warmth, efficient nursing and treating symptoms as they arise give the best results." This is dated the 10th December 1898. Since writing the above I find that the total mortality since the 20th November 1898 is 45 per cent.; excluding deaths within 48 hours 24 per cent.

2922. Does that include the inoculated and uninoculated?—Yes, that is the total. "The number of hospital attendants since the opening of the camp is 61. Of these four have been attacked with and died of plague, three of whom were inoculated, a Poona servant being amongst them. Of the 16 Poona servants employed in the camp, the whole are stated to have been inoculated about two years ago."

2923. Can you find out how many of these people who died of plague had been inoculated? You state two years; does that apply only to the present servants?—The Poona servants employed in the camp are stated to have been inoculated two years ago, and I take it therefore that the one who died was inoculated at the same time.

"South Plague Camp.

"This camp was opened on the 29th October 1898 and consists of two large masonry and seven matted wards, besides twelve smaller wards for convalescent patients, six caste and four Gosha huts, in all thirty-one buildings of good plinth, and roofed with corrugated iron, capable of accommodating two hundred cases.

"The camp is supplied with water from stand-pipes. All solid excreta are cremated and liquid filth, etc., removed in suitable carts.

"During the period—about one and a half months—459 patients were admitted, 71 recovered, 256 died, remaining under treatment 132, mortality 55 per cent. The incidence of mortality in relation to age and sex was as follows:—

Under 5 years	6	males and	9	females.
Between 6 and 20 „	46	„	and 29	„
From 21 to 60 „	90	„	and 62	„
and over 60 years	9	„	and 5	„

"According to caste there died 1 Eurasian female, 171 Hindus (103 males and 68 females), 16 Muhammadans (13 males and 3 females), 30 Native Christians (17 males and 13 females), and 38 Pariahs (18 males and 20 females). The duration of illness in total fatal cases was two and a half days; eight were brought in dead, while the mortality excluding cases which died within 48 hours of admission, was 28 per cent.

"Six children developed plague in the wards after the admission of relatives. Fourteen persons also in the contact camp out of a total of 317 were admitted for the disease. None of the hospital establishment was attacked.

"The type of disease in order of frequency was:

(*a*) Plague with superficial buboes.
(*b*) „ without „
(*c*) „ pneumonia and all its varieties of septicæmic plague.

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"The position of buboes with death-rate in each type is as follows:—

Groin	164	death-rate	50 per cent.	41 per cent.
Axilla	71	,,	42 ,,	
Cervical	47	,,	55 ,,	
Face	37	,,	30 ,,	
Multiple	24	,,	30 ,,	

"The mortality in relation to age and sex is higher amongst males than females. The patients admitted appeared for the most part to be of the very poor labouring class.

"The conclusion which may be drawn from the foregoing is that the ward of a sanitary Plague Hospital is the safest place during an epidemic, and that exposure to conditions such as the following are necessary to develop the disease, *e.g.*, overcrowding, destitution, deficient cubic space, ventilation and sunlight, and a filthy and general insanitary condition of person, clothing, habitation and its surroundings." That is also dated 10th December 1898.

2924. (*Mr. Hewett.*)—What are the duties of the Residency Surgeon?—In ordinary times the Residency Surgeon is the medical adviser to the Resident on all matters affecting civil administration.

2925. Upon all sanitary matters?—Sanitary and Medical matters.

2926. Has the Resident directed you not to be responsible for sanitary arrangements?—He has not.

2927. Then I presume you are still responsible?—This is exceptional.

2928. If there has been no order exempting you I presume it is still your duty?—I have not the control of the disinfections as a matter of fact.

2929. How have you been relieved of it?—The disinfection is in the hands of the Chief Plague Officer.

2930. The agency through which the disinfection is effected is the Chief Plague Officer?—Yes.

2931. Are you not responsible for the disinfectants which he used?—I suppose I am responsible.

2932. Have you drawn up a list of the disinfectants?—Yes.

2933. Then are you not responsible? The Plague Officer would not use them unless they were prescribed by you?—I take it this list (see question No. 2707 in this Volume) has been issued under the signature of the District Magistrate.

2934. That is always the case in every district, but the Civil Surgeon would be responsible all the same for the actual disinfectant used?—I suppose I am responsible.

2935. (*Prof. Wright.*)—Is pineoline specified in the list?—No.

2936. To your knowledge has any disinfectant been used which you have not specified there?—No, I do not know that it has. Pineoline has been used in the hospital as I say on my advice.

2937. (*Dr. Ruffer.*)—You gave us some statistics about the North Camp; when was that North Camp opened?—On the 15th September.

2938. And the epidemic began on what day?—That is the date of the first case that was admitted to the camp.

2939. When did the Bangalore epidemic begin?—The epidemic is stated to have begun in the Civil and Military Station before that.

2940. Would you expect naturally that the people you put in the contact camp would be most liable to plague, having been in contact with cases?—Yes.

2941. You have had 29 cases out of 924; that gives, roughly speaking, a mortality of 3 per cent. I think you can take that from me as being correct. Yesterday we were told that the total mortality was 3,597 out of a population which has dwindled down from 84,000 to 55,000. If you calculate this out you will find a mortality of 6 per cent. How do you explain the fact that the mortality in the contact camps, which should be very high, the people having been in communication with plague patients, is nearly lower by one-half than the mortality among the people who were not segregated?—Taking the people away to the segregation camp or the contact camp is quite a different thing to leaving them behind in the town.

2942. You think the difference is due to segregation?—Yes, I am quite sure of it.

2943. The point is that with the people who have been in contact with plague patients you would expect a very high mortality. As a matter of fact it is lower by nearly one-half than the mortality among people who have not been in contact with plague patients?—Yes.

2944. We were told you used Whalley's fluid as a disinfectant. Have you any special knowledge of the antiseptic strength of this solution?—I do not know the composition of it, but I know it has been very largely used in the Health Department of the Municipality.

2945. Have you any evidence to show that it is an antiseptic?—I have not.

2946. What becomes of the friends of the patient who are admitted to hospital with the patient, after the patient is discharged or dies? Are they segregated or allowed to go home?—In some cases they are put in the segregation camp, where they happen to have been a very short time in the hospital.

2947. But if they have been a long time in the hospital?—They are not kept in the segregation camp, but are disinfected and sent home.

2948. Why should they not be put in the segregation camp?—As a matter of fact that has not been done.

2949. (*The President.*)—With regard to the wards in the camp in which the plague cases are treated, is there any definite rule with reference to floor-space?—There is a definite rule.

2950. Can you tell me what floor-space you allow?—At first I thought of having the floor-space so arranged that each patient should have 120 superficial square feet.

2951. But as a matter of fact what is the floor-space?—I do not think it is more than half that.

2952. Is there any good reason for this reduction in floor space?—I think there is; because at this time of the year the same superficial and cubic space is certainly not required as would be required in the hot weather.

2953. Why?—On account of the low temperature.

2954. You wish to maintain the heat by the heat given off by the patients?—Yes; and besides, there are the habits of the people to be considered. I think if the people had too much air and too much space, it would be prejudicial in many cases in a hospital.

2955. Among the patients there are also the friends?—Yes.

2956. Do you think it is desirable that the floor-space should be reduced when you remember that there are also unaffected people in the same ward?—The friends are so very small in number that I can scarcely view that as an objection.

2957. (*Mr. Hewett.*)—With reference to Dr. Ruffer's question as to the number of attacks in the segregation camp, I understand you to think that the ventilation, lighting, and general cleanliness of the segregation camp, as compared with the want of light, want of general cleanliness and absence of ventilation in their own houses, renders persons, who are liable to the same personal contagion, more immune from attacks of plague?—Yes.

(Witness withdrew.)

CAPTAIN B. H. F. LEUMANN, I.M.S., called and examined.

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2958. (*The President.*)—You are a Bachelor of Medicine of London and in the Indian Medical Service?—Yes.

2959. What is the office you hold here?—It is rather various. I came down here as adviser on plague matters, also to inoculate, and since I have been on inoculation work here I have also had the administrative charge of the South Camp Plague Hospital.

2960. At the present moment what is your chief duty?—Inoculation; and I have also the administrative charge of a small hospital in the south camp.

2961. (*Dr. Ruffer.*)—I think you have been engaged in plague work in various parts of the country?—Yes, for about two years.

2962. You were in Bombay, I think, for seven and a half months in charge of the plague ward at the European Hospital?—Yes.

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2963. Have you noticed any difference in the mortality among Europeans and natives?—Being a European hospital it was supposed to contain only European patients, but we did have a few who were not Europeans, and they were brought in rather later in the disease than the others and the mortality among them was higher. I think that was chiefly due to the fact that earlier in the disease they did not have as good nursing as the Europeans had. That was the only reason; I do not think there is any racial protection.

2964. There is no racial immunity?—No.

2965. At that time did you make any examinations of the blood of the patient in order to ascertain whether there is such a thing as a serum-test for plague?—Yes.

2966. Could you tell us how you performed that test and your results?—I tried first of all with convalescent patients and I found that in the serum of their blood.

2967. Perhaps you had better explain the term 'serum'?—Serum is a yellow fluid which exudes out of a blood clot after the blood has been shed from the body, and collected in some vessel. In the serum of a convalescent patient I found a bactericidal substance which killed the plague bacilli when mixed with them.

2968. Could you tell us exactly how you demonstrate the fact that the serum kills the plague bacilli?—I took a tube like a test tube, which was sterile, and having put the blood of the patient into a sterile cupping glass I allowed the blood to settle in a cool place covered over with cotton wool, and when the serum was obtained I caused precipitation among the plague bacilli which were suspended in the sterile water in the sterile tube.

2969. And how much culture did you use?—One or two loop-fulls suspended in sterile water.

2970. How much sterile water?—That was not carefully measured; but the tubes I used were ordinary glass tubes about three-and-a-half inches long; that was the only apparatus I had.

2971. How much serum did you add?—I used to add it drop by drop, and then shake it; I had sometimes to add a quantity of serum quite half the quantity of the distilled water.

2972. How much serum from a convalescent patient did you find it necessary to use?—I never estimated that; but I used to wet-cup them to the extent of a dram and a half of blood.

2973. What occurred?—There was a flocculent precipitate of the dead bacilli at the bottom.

2974. Suppose you shake up the plague culture in distilled water, what happens then?—You simply diffuse the bacilli through the water and then it looks slightly milky; but it depends upon how many plague bacilli you have there.

2975. Suppose you allow it to stand?—I do not know that I have ever noticed that. But I presume they will all fall to the bottom.

2976. Then you get a clear fluid?—Yes, and you can grow bacilli from that, but not from the precipitate obtained by adding serum. I have tried both and they will not grow from the latter.

2977. In the experiments in which you found that the bacillus did not grow, how did you inoculate the tube?—I took nearly a loop-full of precipitate and simply did the cultures on agar.

2978. And you found the bacillus did not grow?—Yes.

2979. Do you attach any diagnostic value to Widal's test in the case of the plague bacillus?—Most distinctly.

2980. At what period during the convalescence does it occur?—I cannot exactly state that; it never occurs in a patient so far as my experience goes who does not convalesce. In a patient who is going to convalesce I have found it on the fifth day of the disease, in two out of one hundred examinations altogether.

2981. I think after that you were engaged in plague duties in Lanauli from the end of July to September 1897?—Yes.

2982. You have had some experience of Yersin's serum?—Yes.

2983. Will you give us your experience?—It is rather a long time ago, but I can tell you roughly how many cases were treated. Twenty cases were treated and no exception was made as to whether they were likely to recover or not. They were treated immediately on coming to the hospital, and varying quantities of Yersin's serum from 80 c.c. to 250 c.c. were injected at different times, about 30 c.c. at a time, and the results were that 12 died and eight recovered. Two of the eight had a very marked chronic affection of the shoulders and knees. One man in particular distinctly had a very large swelling of the knee, first acute and then chronic.

2984. Was it at all similar to the swelling produced by inoculation of diphtheria serum?—I have only seen two cases inoculated in that way.

2985. Then the mortality after the use of Yersin's serum was practically 60 per cent.?—Yes.

2986. What was the total mortality of the hospital at the time?—It was rather more; but then the sanitary conditions of the hospital were extremely bad. At that time they had an average rainfall of 14·57 inches per month, and we could not save anybody. I think it was an improvement on the other mortality.

2987. Did you notice any special symptoms after the inoculation of Yersin's serum?—Yes. One of the most marked was the rapid fall of temperature. I took it to be shock as much as anything, because of the large quantity of liquid injection, and this was usually followed by a rise, which was very often higher than the temperature at the time when the injection was made. It did in one or two cases seem to reduce the delirium in unconscious patients, but I should not like to give a definite opinion as to that.

2988. Did you notice any effect on the bubo?—Yes; in one case in a European in the General Hospital in Bombay there was a marked effect on the bubo, after the injection with Yersin's serum, I think, on the fourth day. I thought it was going to suppurate, but it became very small and disappeared within a week.

2989. Were the cases which you inoculated chosen in any way or did you take every case entering the hospital?—In Lanauli we took twenty cases as they came in the hospital.

2990. Do you think they were a fair sample of the usual cases?—Absolutely.

2991. There was no choosing or picking of cases?—Absolutely none.

2992. Then I think you had some experience at Sholapur with regard to segregation and disinfection?—Yes.

2993. Perhaps it will be better to postpone that part of your evidence. We will now go to Hubli where I believe you were extremely active from April 2nd to October 3rd?—Yes.

2994. During which time did you inoculate a very large number of people with Haffkine's prophylactic fluid?—Yes.

2995. Could you tell the Commission how you proceeded to test and examine the prophylactic fluid?—I did not know at the time that it was necessary for me to test or examine it.

2996. I mean to test its strength by standardising it?—It is standardised before we get it. But I found from experience that some of the doses stated on the bottle did not give sufficient febrile re-action.

2997. How did you come to that conclusion?—By a simple observation.

2998. How were these observations made?—First of all on the members of the hospital staff and later on we made control experiments with every batch of lymph sent on persons in our segregation camp. If we received one hundred bottles, say, we would use one or two on ten or twelve persons.

2999. How much does each bottle contain?—It varies. Sometimes it contains 10 c.c., and sometimes 200 c.c. The bottles vary in size and they are not always filled to the same extent. On every batch of lymph we made control experiments, and having roughly gauged what the amount of re-action was upon ten or twelve persons in the segregation camp, and finding that the re-action was really too little, I wrote to Haffkine in Bombay asking his permission to increase the doses, and I almost invariably increased them.

3000. Could you give us the exact details of one set of experiments; for instance, could you tell us the maximum temperature you obtained?—I have not the figures by me, but I can tell you. [*Notes.*—Witness subsequently intimated that the maximum temperature noted by him was 106°.]

3001. You can add them to your evidence?—Yes, I have rough notes of all these things.*

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* *Note.*—The witness did not submit his notes, and on being asked for them he replied by telegram on the 23rd February 1899 as follows:—"Cannot find these notes. My kit nearly packed, expecting to go abroad, but I explained all I could in my evidence."

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3002. How often were these temperatures taken?—Four times a day.

3003. Beginning before the inoculation?—Yes. All the temperatures were taken before inoculation, and then they were taken regularly every four hours afterwards.

3004. How many different brands of lymph did you get during that time?—Different dosages; I do not think they were different brands.

3005. (*The President.*)—Different consignments?—We got about one hundred different consignments, but the dosages and so on were exactly the same or nearly the same.

3006. (*Dr. Ruffer.*)—What do you consider the right temperature?—Not less than 102°; I think we ought to get the re-action up to that.

3007. When you made these experiments on eleven or twelve people, did you find there was a great difference in the fever produced in the various individuals?—Sometimes, but not always. One group of lymph would give far less re-action than another, and the personal equation of course comes in as well.

3008. Did you find any difference in the action of this prophylactic fluid on women, children, and adults?—Yes. Children stand it far better.

3009. According to the instructions given, I suppose you give children a smaller dose?—My experience is that they can take larger doses proportionately. It is a long time since I have seen the instructions and I have been acting on my own experience. In my experience you can give children a proportionately larger dose, judging by the doses which you adopt in drug prescriptions.

3010. (*The President.*)—The total dose is not really larger but proportionately larger than that given to adults?—Yes, according to age and fighting weight. I think fighting weight is a far more important factor to take into consideration than anything else in giving the dose.

3011. (*Dr. Ruffer.*)—Did you have to reject any of the fluid sent to you?—Yes, we did.

3012. Much of it?—No.

3013. What proportion?—I could not tell you, but very little.

3014. Could you give us a rough estimate as to how many bottles you refused; did you find, for instance, that any one whole consignment was wrong?—Never over one per cent. of a consignment.

3015. A certain number of bottles in a consignment might be wrong?—Perhaps one out of one hundred, but not one out of every hundred nor every thousand.

3016. When you proceeded to inoculate people, what precautions did you take against possible septicæmic processes?—I had my syringes and needles and so on all sterilised beforehand.

3017. How did you perform the sterilisation?—Usually by boiling carbonate of soda solution, 3 to 5 per cent. I gave that up because I got my rubber corroded and I went in for carbolic acid.

3018. For how long did you disinfect with carbolic acid?—An hour.

3019. Then you disinfected the skin, I suppose?—Yes.

3020. Five per cent. carbolic?—Yes.

3021. And inoculated on which side?—The left arm.

3022. Did you keep a record on the certificates which you gave to patients of the brew of the fluid you had used?—We did at first, but we got so many thousands that it was impossible. We kept the records of the doses. We were unable to keep the records of the brew. They sent us different brews in the same consignment. You might get ten in one box or fifty in one box, and it was almost impossible when inoculating 500 or 600 persons a day to note down four or five figures or letters for the brew.

3023. When you got ten or fifty brews sent you, did you make control experiments to test each brew?—No. The control experiments were made for two months only.

3024. Practically then some brews were used without any experiments?—A good many.

3025. Without any standard except what you found on the bottle?—Yes. I wish to explain that I could not really gauge the strength of the re-action obtained in some of those things at first, and so I concluded that a larger dose was necessary, and I asked permission of Haffkine to give it. Having obtained that permission, I invariably availed myself of it in Hubli.

3026. Certain brews of plague prophylactic were used without having been standardised on human beings?—Quite so, for the simple reason that I had no time.

3027. How many do you think on an average?—It is impossible to say. I could not give you any idea. But for two months out of five months' inoculations I did control experiments.

3028. And for three months you did not?—For three months I did not.

3029. Did you notice any evil effects after inoculation?—Never due to the inoculation itself.

3030. Did you, for instance, notice very high fever?—Certainly.

3031. To what extent?—Fever lasted sometimes for a week or ten days.

3032. Did it go up to 107 or 108?—I had seen exceptional cases in which it went to 106, but I think they were malarious subjects.

3033. Did you ever get any giddiness or faintness?—Certainly.

3034. Did you see abscesses?—Out of 75,000 inoculations done in Hubli there were twelve abscesses.

3035. Did you ever get any enlargement of lymphatic glands on the same side as the inoculation?—Occasionally.

3036. Very marked?—No, and never suppuration in them.

3037. I believe you have inoculated a great many cases twice?—Yes.

3038. Will you give your reasons for this?—I explain it in the first two paragraphs of my Report on "Preventive Inoculation against Plague in Hubli from May 11th to September 27th, 1898,"* which I put in.

"I.—In such diseases as typhoid fever and cholera, if the serum taken from the blood of a patient who has recently recovered from an attack, or from an immunised animal, be added to virulent bacilli of the disease, certain phenomena, characterised chiefly by the agglomeration and precipitation of these bacilli, and their consequent destruction, are capable of being demonstrated. The agglomeration re-action can easily be seen under the microscope and is known as Widal's test, while the precipitation test—first enunciated by Durham—can be demonstrated in either a capillary tube (Wright of Netley) or small test-tube (Pfeiffer): and both these tests are also readily obtained when the serum of a patient convalescing or recently recovered from plague is added to virulent pest bacilli.

"Yersin's curative plague serum, obtained from horses after they have been inoculated with successive large doses of plague bacilli, also shows this result; and Wright's inoculations against typhoid fever, after the febrile re-action caused by it has passed away, present in the serum taken from the blood of the person inoculated a similar 'bactericidal' re-action with typhoid bacilli (*i. e.*, the bacilli of that disease are destroyed by such serum).

"II.—Arguing by analogy I endeavoured over a year ago to prove that the serum of a person recently 'Haffkinised'—*i. e.*, inoculated by Professor Haffkine's method against plague—would also be bactericidal to plague bacilli, and thus afford a practical ocular demonstration of the actual protective value of such inoculation: but although I experimented with the serum from several persons inoculated by Haffkine's staff, I failed at first to obtain any such re-action. Somewhat later, however, I did find in the serums taken from persons who had been inoculated twice similar bactericidal properties against virulent plague bacilli to those met with in the serums of persons who had recovered from the disease. I did not, indeed, obtain these re-actions in every case, but in a goodly number." I have that at home.

3039. Perhaps you will hand that in?—It is private work, but I am quite willing to do so.† "I did not indeed obtain these re-actions in every case, but in a goodly number, and those had been inoculated twice with a full dose of the prophylactic each time within six weeks of my seeing them; so I argued therefrom—rightly or wrongly remains to be proved—that it would be better in inoculating natives against plague to inoculate them twice within a comparatively short space of time, and thus give them the fullest protection possible for a certain period, *e.g.*,

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* See Appendix No. XV in this Volume.

† See note on p. 120.

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six months, which I considered such inoculation might be fully protective for."

3040. There is one point in your paper which I am not sure I have followed exactly. You say if you mix typhoid serum with typhoid bacilli, the typhoid bacilli are destroyed?—You get an agglomeration and precipitation.

3041. Did you not say it killed them?—Yes.

3042. Is that destruction complete or incomplete in typhoid fever and in cholera?—It is not complete. It was demonstrated to me by Professor Pfeiffer in Bombay that the bacilli were killed because we tried to make cultures and failed.

3043. In your opinion they are destroyed?—Yes.

3044. Practically the reason why you gave the second dose is that after the second dose you found Widal's re-action in the blood, and you thought Widal's re-action was a test for the immunity of the person?—I did think so.

3045. And are you of the same opinion now?—No, I do not think so now; I do not think you need go so far.

3046. After the first inoculation you examined a number of people who had been inoculated?—Yes.

3047. Up to what period after the inoculation?—In Bombay I examined about 15 persons. I think up to 10 days or 12 days.

3048. The re-action was not present then?—It was not present.

3049. Who tells you it might not appear afterwards?—No one.

3050. So that it is simply a guess that it is not present?—Yes, but it appears so quickly after a mild attack of plague that I considered it ought to appear after Haffkine's inoculation.

3051. On the 5th day?—Yes.

3052. In the first inoculations which were made in Hubli were the Europeans inoculated first?—No; the first class of community to be inoculated in Hubli was the Musalman community; they provided over 4,000 out of 6,000 first inoculated.

3053. Did you find that the higher classes of the community came to be inoculated before the lower classes?—They did not at first; it was just the other way.

3054. That has not been the general experience in India?—No, it has been generally the other way; but Hubli is an exceptional place, because the higher classes are represented by the worst class of Brahmanism.

3055. How did you induce people to be inoculated?—By persuasive measures generally; I induced them in this way. I held out certain advantages to them and said if a man were inoculated twice and his family were also inoculated they would not be sent to the segregation camp at all, and I allowed them after the disinfection of their houses to remain in them.

3056. You have given us the census of Hubli in your Report* and you have given us the figures for inoculations, and you say in your Report, "As a matter of fact the above figures are not quite representative, for no account has been taken of those inoculated persons who may have left the town. Allowing that the inoculated persons left Hubli week by week in the same proportion as the uninoculated, we make no prejudice in favour of the inoculated when we correct the figures as follows." You then give the correct figures. We have here the statement of Mr. Cappel, Acting Commissioner of the Southern Division, who as a Collector was in charge of Dharwar during the plague, and I find certain discrepancies between your figures and his. I would point out to you that the dates which you and Mr. Cappel give are not exactly the same. For instance, you take your first week ending June 14th, and his first week ends June the 17th, and there is a difference of three days right through your paper and his. Perhaps you could explain why that is?—I cannot explain it except that I was at Hubli and the Collector was 14 miles away. He asked me for the figures and then made his own up according to his own ideas; I objected to the whole thing from beginning to end, because I was the only man responsible for these figures. I really cannot explain anybody else's figures.

3057. I would simply point out the discrepancies between your figures and Mr. Cappel's?—It is obvious when there is a difference of three days that there must be some discrepancies.

3058. But up to August 16th in your statement and August 19th in Mr. Cappel's statement the figures are exactly the same?—That I cannot explain.

3059. I would point out the discrepancies and perhaps you will take a note of them for further reference. In August 16th you say there were 40,441 for the total, 29,756 inoculated and 10,685 non-inoculated. Mr. Cappel says for August 19th, 40,441 total, 30,477 inoculated and 9,964 uninoculated?—I can explain that. As a matter of fact during the stress of plague duty the census as handed in by the Chief Plague Officer was not always quite correct. I am giving you corrected figures week by week which I also notified to the Collector, and I rather fancy he did not put them into his statement.

3060. He did put them in the first part?—Yes, but during the earlier part of the period to which the statements refer we had not such special work. Later on we were not quite sure of our census, and it was taken over again in one or two instances.

3061. And yet when you add the inoculated and the uninoculated in Mr. Cappel's and in your statement you get the right total in both cases?—Quite so.

3062. You are not responsible for Mr. Cappel's figures?—No.

3063. You stick to your own figures as being correct?—They are correct as far as I am able to judge.

3064. I will simply point out the discrepancies† so that there may be no mistake. On August 23rd your total is 39,400, 33,033 inoculated and 6,367 uninoculated; Mr. Cappel's figures for August 26th are 39,400 total, 34,612 inoculated and 4,788 uninoculated. You notice there is a difference of more than a thousand between the uninoculated figures in your list and Mr. Cappel's. On August 30th your figures are 38,210, 34,116 and 4,094. Mr. Cappel's for September 2nd are 38,210, 37,196 and 1,014. That is a difference of nearly three thousand. Then if you add up your inoculated and uninoculated together, you do not get your total of 38,382 for September 6th. Your figures are (September 6th) 38,382, 35,469 and 2,731, and Mr. Cappel's (September 9th) 38,382, 36,795 and 1,205. On September 13th your figures are 38,408, 37,292 and 1,116; and Mr. Cappel's are 38,408, 37,392 and 1,016. On September 20th your figures are 39,142, 38,205 and 937; while Mr. Cappel's (September 23rd) are 38,408, 38,265 and 143. On September 27th

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* See Appendix No. XV in this Volume.

† The following is a tabulated statement of discrepancies:—

Captain Leumann.				Mr. Cappel.			
	Total.	Inoculated.	Non-inoculated.		Total.	Inoculated.	Non-inoculated.
August 16th	40,441	29,756	10,685	August 19th	40,441	30,477	9,964
„ 23rd	39,400	33,033	6,367	„ 26th	39,400	34,612	4,788
„ 30th	38,210	34,116	4,094	September 2nd	38,210	37,196	1,014
September 6th	38,382	35,469	2,731	„ 9th	38,382	36,795	1,205
„ 13th	38,408	37,292	1,116	„ 16th	38,408	37,392	1,016
„ 20th	39,142	38,205	937	„ 23rd	38,408	38,265	143
„ 27th	39,315	38,712	603	„ 30th	39,315	38,806	509

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your figures are 39,315, 38,712 and 603; while Mr. Cappel's (September 30th) are 39,315, 38,806 and 509. You are satisfied that your figures are correct?—As far as possible. I do not say that there is not an error in one or two cases.

3065. How were your figures obtained? For instance, did you take the number of inoculated from your own register?—Yes; there was also a weekly census taken with the exception of five weeks, from the 11th May to 14th June. Our supervision system was not quite formed then. The census fell to 47,427. I said nothing about these four weeks because I could not be certain about them, but with regard to the other weeks I can be practically certain.

3066. Did you reject a certain number of people who came to be inoculated?—Yes, I have done so, wherever I have been.

3067. What is the average number of people you rejected in Hubli?—Very few. I do not know whether it was more than 1 per cent.

3068. What were the reasons which induced you to reject them?—Fever: that is to say, high temperature, and occasionally we had plague cases come up. That was very seldom, because a plague patient is not usually able to come.

3069. Did you reject any one for Bright's disease or diabetes?—No, because in a crowd like that you could not tell if a person had Bright's disease unless it was very marked.

3070. Some of the doctors who inoculated did reject for these diseases?—I cannot be responsible for what other people do.

3071. Did you have any number of people dying 48 hours after inoculation?—I forget the exact numbers, but there were some cases.

3072. Many cases?—Not many as compared with the total. I really could not tell you the exact number, but certainly not very many.

3073. Have you held any *post mortem* examinations on these cases?—Yes.

3074. Could you give us the results of your bacteriological examinations?—Yes. I examined in Hubli, Sholapur and Bombay altogether 41 cases. I did not do the regular *post-mortems*, but what I did was to cut into the spleen and take the blood, and in every single case I found the plague bacilli. In a few cases, about 10, I verified that by passing through animals. In Bombay I was working in a laboratory where that was possible; in other places I was not.

3075. Did you ever find that several people inoculated with a certain brand died within 48 hours?—Yes, and others did not. From one bottle I once inoculated 10 or 15 men. One man died within 48 hours, but all the others would be alive, and as far as I know are alive to-day.

3076. Had you any difficulty in ascertaining the cause of death in Hubli?—No, because we had two men appointed specially to give death certificates.

3077. Medical men?—Yes. Part of the time we had an Assistant Surgeon who was qualified in Bombay; at another time we had an Assistant Surgeon and a rather high class Hospital Assistant. They saw every case, and without a permit no case was allowed to be buried. In every doubtful case for a large part of the time the corpse was taken to the *post mortem*.

3078. For how long?—For over three months, from the beginning of April to the end of July.

3079. Did you find that a certain percentage of people were found dead in the streets?—Yes.

3080. Was that a large percentage?—No, it was distinctly small,—smaller taking it all round than in other plague epidemics.

3081. Is it smaller or larger than in Bangalore, for instance?—A great deal smaller, infinitely smaller.

3082. How did you ascertain whether a person found dead in the street has been inoculated?—We made enquiries from the people close by. We searched the body to see if there was any ticket or certificate, and then examined for the sign of inoculation on the arm. In many cases we found one of the three, either the ticket or certificate or the sign on the arm, that the man had been inoculated; or we ferreted out his name and then looked it up in our register. In some cases we were not able to find it at all: nobody could.

3083. Supposing nothing was found, how was that man classed in your statistics?—He was classed as inoculated or uninoculated according to the percentage of the inoculated and uninoculated persons. For instance, if you take any single case, you will find there will be so many inoculated and so many uninoculated. So many dead bodies were found and we impartially divided them between the inoculated and the uninoculated, so as not to favour the inoculated persons.

3084. Did you divide them according to the percentage?—Yes.

3085. Did you find that both inoculated and uninoculated persons left the town?—Yes, but I rather think that more uninoculated persons left than inoculated. Still there was difficulty about that, because the inoculated persons used to live just outside the town for a few days while their houses were disinfected, and then they came back again.

3086. If a person had a certificate of inoculation was he allowed to leave the town?—Ten days after he was inoculated.

3087. So that a great many people got inoculated in order to leave the town?—Possibly; but I think a great many more people got inoculated to avoid segregation.

3088. A certain number got inoculated in order to travel?—Yes, business men and so on. They had to, because they were not allowed to go in any other way.

3089. Do you think these certificates were passed on from one man to another?—No; it might have been done in a few instances, but a man is not likely to get inoculated once in order to give his certificate to another man, and still less likely is he to get re-inoculated for that purpose.

3090. That is your opinion?—Yes, I am rather keen on that, because it was suggested at Hubli and by various people in the Bombay Presidency, and I am pretty certain that that idea is absolutely unfounded.

3091. You do not think these certificates were sold?—No.

3092. Supposing a man found a dead body in the street would he not have an interest in taking that man's certificate away?—Yes, he might have.

3093. Did you find many certificates on the people who were discovered dead in the streets?—Yes, quite half the number. In many instances we found nothing, but we counted some of these people as inoculated persons.

3094. Did you find nothing in quite half the number?—Yes.

3095. Have you any evidence of men having had plague twice?—I have heard of it.

3096. You have never seen a case?—No.

3097. Have you any evidence as to the duration of immunity produced by inoculation?—I have not been inoculating long; I did a few inoculations in Bombay in 1897, but I have only really taken it up since May of this year.

3098. Have you any evidence as to the length of time that a man remains immune after inoculation?—I have a recent report from Hubli showing that there is hardly a death or an attack among the inoculated people there, whereas other people coming into the town got plague and died.

3099. What is the mortality now in the whole town of Hubli?—I cannot tell you exactly.

3100. It is very low, is it not?—It is low, but last week's plague report said that out of 1,016 uninoculated there were 12 deaths, and no deaths among the once and twice inoculated numbering 35,500.

3101. Is that hearsay?—I read it in the newspapers.

3102. Did you take any other measures in Hubli beside inoculation?—Clearing out the areas.

3103. Segregation and disinfection?—Yes.

3104. At Bangalore you inoculated about 15,000 people?—It comes to just over that.

3105. Have you any statistics as to the mortality among the inoculated people?—They are very hard to get in Bangalore but I hope to get some.

3106. You have none at present?—Nothing I should care to lay before the Commission.

3107. Have you any facts referring to the inoculations in Bangalore which you would like to place before the Commission?—No, I do not think so, except that it is perhaps a little more difficult to inoculate here.

3108. In Bangalore are the people who come up to be inoculated chiefly Musalmans or chiefly Hindus?—Hindus, Pariahs, and Native Christians.

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3109. Do you know whether there is any difference in the mortality from plague among the Hindus and Musalmans?—I could not tell you.

3110. It is very nearly double amongst the Hindus, is it not?—They are very numerous, I fancy.

3111. I mean the percentage; can you explain that in any way?—I have no facts, but I should say it is due to the low caste people living in very insanitary areas. Undoubtedly that must be a very great factor in the mortality.

3112. Have you any experience as to animals getting plague?—Yes.

3113. Will you give us the facts on that point?—I saw several monkeys and proved they died of plague in Hubli.

3114. By bacteriological examination?—Yes.

3115. How many monkeys?—I examined eight, but I have seen heaps of other monkeys dead about the streets, and they all cleared off when the epidemic became severe.

3116. Have you any evidence as to squirrels and other rodents dying from plague?—Yes, and it is possible they communicate it.

3117. Could you give any evidence upon that?—One very marked case was in the goods shed at Hubli, in which the unloading coolies kept on dying during the end of April and the early part of May. Then suddenly they reported a frightful stench; the floor was taken up and hundreds of rats were found dead, some who had recently died. We examined them microscopically and they had bacilli in the blood like plague bacilli, and we presumed they were plague bacilli.

3118. But no special bacteriological examination was made?—No.

3119. Have you any evidence as to squirrels getting plague?—I have examined one squirrel only, and then only by the microscope; that had bacilli in its blood like the plague bacilli.

3120. Did you know of any other squirrels dying in plague-infected districts?—Yes, I have seen dead squirrels, but they seem to clear off more quickly even than the rats.

3121. Have you any evidence as to plague being communicated by clothing?—Yes, I have known people make off with their clothes from one house where a plague case was reported, and we traced these clothes to other parts of the town by the deaths of people which occurred in houses in uninfected areas of the town. One case occurred in Hubli in which a woman escaped segregation and disinfection of her kit, and after we allowed the people back again in the same area, her child died of plague. Her clothes were stolen by a Musalman and she complained to the Police. The Musalman died of plague about three days afterwards in an uninfected area. We found the clothes had been again taken by a policeman whose brother died of plague three days after that. We never got these clothes, and they were passed on into the house of a clerk of the railway, and several people living in that house died.

3122. What became of the clothes after that?—We never got them. Undoubtedly from the news we received those clothes had been taken from one house to another. We put detectives on to try and get them.

3123. (*Mr. Hewett.*)—With regard to inoculations in Hubli, you say the total population was found out by the second census?—I do not say that always. You can quite understand that when there are two British officers to run a town of 55,000, it is not altogether the easiest thing in the world to get a census. When I thought the matter was not accurately done, I re-investigated it. In the meantime the record had been handed in to the Collector to be sent to Government; and it is for that reason only that those not very great discrepancies which have been pointed out arose.

3124. The population of Hubli is estimated at 57,000 and you have an assumed population which ranges from 42,000 to 47,000?—I do not know that that population is assumed; it was accurate because it was counted.

3125. Is not taking a census a difficult thing?—I call it assumed because it was taken without the precautions which are required when you have to take a census; it is impossible to arrange for a census at a moment's notice. It took us four weeks to get the census first of all.

3126. You found only 47,000 persons?—Yes.

3127. That is the figure from which you start?—Yes.

3128. You calculate the rest of your figures according to the estimated number of arrivals and departures?—Yes.

3129. About which you cannot be perfectly certain?—You can be very largely certain about it—it is a trading centre, and there were inducements held out to the people to register their names and appear at certain times and answer to their names. It is a large cotton trading district, there are a lot of weavers and so on, and we promised them that they would not be segregated if they would register their names in the census. The people themselves did a great deal of registering. The first thing a man did after he got the certificate was to come up and say he was not to be segregated.

3130. Then you think the figures are approximately accurate?—Yes, as accurate as possible.

3131. When you found a dead body upon which there was neither a certificate nor a ticket nor a mark, was it regarded as uninoculated?—No, I have just explained that it was not. I explained that we counted the number of those unknown bodies.

3132. I am not talking of the unknown bodies but of persons who died in a house. Did you always get certificates in those cases from everybody that was inoculated?—It was not difficult in such cases, because we immediately turned up the supervisor's list to find if he had been inoculated or not. If he had been inoculated, he would have taken care to explain that he was not to be segregated.

3133. You found no difficulty in tracing them?—No.

3134. I understood there was a difficulty: we were told at Hubli that they could not trace out the people?—There were no people in Hubli at the time who were on the spot throughout the epidemic.

3135. We were told that by Assistant Surgeon Cardoz?—He had practically nothing to do with the plague except the inoculation—absolutely nothing to do with the running of plague measures.

3136. Was he not responsible for examining bodies of people who died there?—No, he was not; he was not appointed by me.

3137. I think he said so?—He examined a few whom he was asked to do, because there was a stress of work.

3138. It has been stated in evidence, not by you, that you consider that the period of incubation may extend beyond ten days; do you believe that?—I do in some cases.

3139. How long do you think it extends?—I believe in two or three instances I have seen it extend up to 15 days or more.

3140. Was it absolutely certain that there had been no subsequent contact with plague?—As certain as one can be in India.

3141. Can you ever be certain that people who are in the segregation camp do not get out?—Practically in walled-in places—I mean to say in a fort with walls 20 feet high and guards at the gate—you can be fairly certain.

3142. You have to assume that the guard is to be relied upon?—I grant that.

3143. So that the discovery of three or four cases of that sort, would not furnish sufficient ground for saying that the period of incubation may be 15 days?—I do not say that it is the general opinion.

3144. It was given as yours and I wanted to clear it up?—That was taken out of a medical paper to which I wrote a letter.

3145. Mr. Cappel made the statement?—I do not think that was authorised, certainly not by me. I wrote a letter in answer to an enquiry once, but I have never stated that officially.

3146. There were three or four cases in which probably the period of incubation was more than ten days, but you cannot say that there is no element of doubt in the matter?—There is an element of doubt about everything, I suppose, but as far as one can be absolutely sure, I am sure. I have no reason to suspect the guard.

3147. I think you said that the persons inoculating in Bangalore do not now give smaller doses for children?—No, I did not say that, or if I did I never meant to.

3148. Is it the case that smaller doses are given to children at present?—Smaller doses of anything are given to children; you would not give children the same dose of opium as a grown-up person.

3149. I understand you mean that they can take it better?—They can take proportionately larger doses.

3150. But there is a definite limit as to the amount to be given to a child of each age?—No; I take it that you judge

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the child first of all by its fighting weight and secondly by its age.

3151. I saw a list in the hands of the native doctor; was he working on that?—Yes, I advised him, but he modifies that; it is very hard to be quite accurate.

3152. Is not the difficulty increased by some of the bottles being 12½ c.c. and some 2½ c.c.?—I do not think so if you have an intelligent native officer.

3153. At present we are only dealing with the outbreak in one or two places, but if inoculations are to be made popular it may be necessary to have inoculators all over the country; would not it be made easier if there was a definite dose which is always to be given?—Yes, but I hope you will have intelligent men to inoculate and not entrust it to the hands of anybody.

3154. It increases the difficulty when you are inoculating a large number of people?—Yes, it might.

3155. Is it not as well to make everything as easy as possible?—Yes, but the question is whether you can get it; I believe it is very hard.

3156. Do you not think it would be an important thing if it could be done?—It would be very much better for inoculators.

3157. It would reduce their work immensely, would it not?—Yes.

3158. With regard to the inducement given for inoculation, was it not made a rule at Hubli that nobody should go back to their houses unless they had been inoculated?—No, there was no such rule.

3159. Was it made a rule that they should not leave by rail unless they had been inoculated?—Yes, there was that rule, and they could not get the road or rail pass unless they could show the inoculation certificate bearing date of the second inoculation ten days previously to the time they applied for the pass.

3160. You have had nothing to do with Dharwar?—No.

3161. They had not the same rule at Dharwar as you had?—No, we rather made our own rules and they were changed afterwards by Government.

3162. You do not do many second inoculations here, do you?—No.

3163. Is it not rather likely to make the inoculations less popular than they might otherwise be if people have to be inoculated twice?—No; judging by Hubli, it seems to make it rather more popular. It depends what you are going to give in exchange for inoculation.

3164. Why were the people who had only been inoculated once not exempted from segregation?—Because I wanted to be quite sure that they were protected.

3165. Is it not in accordance with the orders of the Government of India that they should be exempted?—It may be so now, but it was not so then; so far as I know there were no orders, at least I got none.

3166. (*Mr. Cumine.*)—I understand there was a census taken first of all and then another census taken afterwards?—There was a census taken at first before we began the inoculations. There was a weekly census to show us the population and how many of them were inoculated and uninoculated. That was checked by our books, and if there was any discrepancy the question was gone into again. In the meantime the report had to go in to the Collector and occasionally there was an error of perhaps 700 or 800 out of 20,000.

3167. Was the census taken every week, or was it taken twice during the epidemic?—It was checked every week.

3168. There was an inducement to inoculated people to get themselves registered?—Yes.

3169. Was there any inducement to uninoculated people to get themselves registered?—I do not see how there could be.

3170. There was none then?—The idea was to get the people inoculated, not so much to get them registered; but the inoculated people registered themselves as having been inoculated with their ticket numbers, and then they were exempted from segregation. That was the idea. It was very largely followed, but it was not followed wholly.

3171. I want to know to what extent the numbers of the uninoculated depend upon assumption. There was inducement to inoculated people to get themselves registered, but what inducement was there for the uninoculated to get on the census?—They were on the census already.

3172. On the first census?—Yes.

3173. As they kept leaving the town or coming into it their numbers altered?—Yes.

3174. What was the means of keeping the number of uninoculated people present in the town correct?—Merely a check of the census by supervisors and superintendents who went round on Saturday morning and spent about three hours in their different wards. Each man had a ward of about a hundred houses and he spent a large part of Saturday morning in checking the census in his list.

3175. Was there any test taken by Europeans of the correctness of the census of the uninoculated?—The Chief Plague Officer, who was a Subaltern of the Staff Corps, was really responsible for the census, and used to investigate all discrepancies.

3176. Discrepancies on paper, but did he go round the houses and take tests?—Certainly.

3177. One European did that in the whole of Hubli?—In different parts of Hubli.

3178. But there was only one European to do it?—There were only three Europeans on plague duty there altogether.

3179. The census, which the Superintendent had, contained a note against each person named in the census stating whether he was inoculated or uninoculated?—Yes. Those were my instructions, and to a very large extent they were followed out; of course all sorts of difficulties arose; the supervisor decamped and another had to be appointed, and the whole thing had to be gone through again, and so on. Errors might arise, but they were not very great because the position and the trade of Hubli rather lend themselves to take a census. It is a large cotton district and it is the head market of the whole Southern Mahratta Country. There are large cotton mills and the people live on the spot, and some of them who were not inoculated were very loath to leave it really except through fear, but directly they found that inoculation protected them the people would not even go out to live in jopdies (huts) outside the town, but kept in their own houses.

3180. At the worst period of the epidemic I suppose fifty or sixty people were dying a day?—More, sometimes; I think 84 was the highest number.

3181. Who decided in the case of each of these persons whether he was inoculated or uninoculated?—There were different doctors for different wards. There were two Assistant Surgeons and a Hospital Assistant deputed during the height of the epidemic, there was also the Assistant Surgeon of the Civil Dispensary, a practitioner in the town qualified in Edinburgh, the railway doctor and his assistant and two medical officers on plague duty.

3182. Was there any European who took tests to ascertain the correctness of the report and to say "so and so is dead, inoculated, and so and so is dead, uninoculated"?—When a body was seen the certificate was nearly always given up with it. The certificate was immediately demanded and obtained and was filed in my office. I have already explained at great length to Dr. Ruffer what we did in doubtful cases.

3183. (*Prof. Wright.*)—What is the inducement offered here for inoculation? Would the equivalent which a man receives in being inoculated be nothing more than the protection he gets?—I believe now the orders are that they are not to be segregated but they have been changed.

3184. You have done 15,000 inoculations. What has been the inducement offered? Was the only inducement the protection which was afforded?—Partially the protection afforded, but chiefly I believe to escape segregation. But the rules were changed and now they have gone back again.

3185. I understand that the greatest number of deaths which occur in the once inoculated occur in the first few days after the inoculation?—Yes.

3186. Does the same thing hold true in the case of the second inoculation?—I have not worked it out but I suppose it does a little and then drops more suddenly than the others.

3187. You recommend that a second inoculation should be resorted to in all cases, do you not? I understand you have certain *à priori* reasons for that, certain observations which you have made on the blood of vaccinated persons?—Yes.

3188. In addition to this you have convinced yourself of a second inoculation by statistics?—Yes.

3189. I would like to take these things separately. Do

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you think the more vaccine you administer the greater the amount of protection which you obtain—that one inoculation is good and a second is better and a third is better still ?—No, or you might put in a pint instead of a few drops.

3190. No, I refer to repeated inoculations. You recommend two inoculations; I want to see why you do not recommend three. Have you for that any reasons apart from your observations on the blood ?—No, I base everything on that test. I would not take up inoculations till I did find that test. I worked on it at intervals for about a year until quite by accident I hit upon it.

3191. Have you considered the fact that serum which has been got from horses who have been over-inoculated has proved not to exercise a beneficial effect, but rather a prejudicial effect on plague ? Have you weighed the fact that if you give too much vaccine you might conceivably get a worse result than if you gave less ?—No, I have not, but I do not think that a double inoculation is too much.

3192. I do not know either, but have you considered whether there is a possibility of giving too much vaccine even though it is given in graduated doses ?—If you went on indefinitely.

3193. With regard to your observations on the blood, did you take agglomeration as your test in all cases ? In other words did you take as your criterion agglomeration or sedimentation, or the fact that the blood exerted a bactericidal effect on the plague bacillus ?—It was both.

3194. To what extent did you rely on one of these tests and to what extent did you rely upon the other ?—If you found merely agglomeration, were you satisfied ?—No.

3195. Did you always also see whether the blood of the vaccinated person exerted a bactericidal effect ?—I was not able to try for cultures always because I was not always in a bacteriological laboratory, and had not always the material with me.

3196. You have made certain experiments upon which you have based your opinion that a second inoculation would be useful ?—Yes.

3197. Do those experiments consist in testing the bactericidal effect of the blood by means of cultivations ?—They consist first of all in observing whether the bacteria were sedimented and then in making the cultures. After doing that in about ten instances I gave up trying to make cultures.

3198. Because you thought the agglomeration was sufficient ?—Yes.

3199. Did you find that the plague bacteria were already agglomerated in the cultures you employed in testing or did you find they are separate ?—You can get them separate by shaking them about, you make the whole blood opalescent.

3200. Did you examine your bacterial emulsions under the microscope ; had the bacteria run together into small groups ?—It is due to your shaking it up and disturbing it, but you do not get anything like the heaps which you get when you take serum from a plague convalescent.

3201. You think there is a quantitative difference, but not a qualitative difference between the bacterial emulsions which have had an addition of serum made to them and the emulsions which have not had such an addition ?—I think it is distinctly qualitative too.

3202. You said there were already clumps of bacteria in the emulsions which had not been treated with serum ?—I did not mean to say that every single bacillus was separate on the slide, but what I do mean to say is this, that when you make a cover glass preparation of anything you probably get a few gathered together.

3203. You found this agglutinating substance in the blood after the second vaccination and not after the first ?—Yes.

3204. Did you make quantitative estimations of the agglutinating power ?—No.

3205. Did you dilute the blood accurately ?—No.

3206. Is it not possible that you diluted more in one case and less in the other ?—I used a tube of a certain length.

3207. What kind of tube ?—An ordinary glass tube which had been sterilised.

3208. What dilutions did you employ ? I presume that you wanted to dilute your serum a certain number of times and to work with a certain definite dilution ?—Yes.

3209. How did you measure your serum and diluting fluid ?—I used about half a tubeful of the bacilli suspended in sterile water and I added drop by drop from the pipette and shook it.

3210. Do you mean to say that when you tested to ascertain the effect of the first vaccination you may have added two drops of serum to your emulsion and that when you tested the blood of your twice vaccinated person you may have added one hundred drops ?—I do not know how many, but I went on adding drops, till after standing I got a good agglomeration.

3211. If you had added sufficient drops, might you not have got agglomeration by means of blood taken after the first inoculation ?—Probably, but I should not have been able to see it so well. I understood the test was to be done and I followed it according to what I had read in books.

3212. It is then merely an assumption that the dilution which you employed in one case was the same as the dilution in the other ?—Yes ; I used the pipette method also, and found it exactly the same there.

3213. In what proportion of the twice vaccinated cases did you find this re-action in the blood ? You said you did not find it in all ?—I cannot tell you exactly, but I can let you know.

3214. Can you put in the series of observation on which you based your opinion ?—I cannot, but I can tell you exactly in how many instances I found it.

3215. Can you give us any facts upon which we can judge that you based your opinion as to the necessity of a second inoculation upon good evidence ? You have given the opinion and we want to know what bases there is for that opinion ?—I do not suppose it will satisfy you.

3216. I want such evidence as any reasonable man would consider sufficient, that is all. Independently of these observations have you found that statistics bear you out in your opinion that a second vaccination ought to be resorted to ?—Yes, I have handed that in* and I show here roughly a ten per cent. improvement. I believe it has been found even greater in Dharwar, but I am not sure.

3217. Do you approve of making a second inoculation in the same region as the first ?—There is no reason why it should not be if the signs of the first have altogether disappeared.

(Witness withdrew.)

(Adjourned till to-morrow.)

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* See Appendix No. XV in this Volume.

At The Mayo Hall, Bangalore.

TWELFTH DAY.

Wednesday, December 14th, 1898.

PRESENT:

PROF. T. R. FRASER, M. D., LL.D., F. R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

Mr. V. P. MADHAVA RAO called and examined.

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3218. (*The President.*)—As Member of the Council and Plague Commissioner of Mysore, you have had charge generally of the plague measures at Bangalore?—Yes.

3219. Will you kindly give us your views asto the origin of plague in this city?—The plague was undoubtedly introduced into Bangalore from Hubli. It began to assume epidemic proportions in Hubli in April 1898, though there had been sporadic indigenous cases for several months before that. As early as December 1897, precautionary measures were begun to be adopted here, of which the chief were—(1) medical inspection of passengers from infected areas and their escort from frontier stations; (2) careful watch over all arrivals, departures, and cases of sickness and death in the city, under what is known as the "Supervision system;" (3) accurate registry of deaths at the different burial and cremation grounds; (4) the destruction of rats; and (5) the prohibition of import of rags from infected areas.

3220. These do not include any sanitary measures?—As a matter of fact of course we began to give attention to that from the commencement.

3221. But notwithstanding all the measures you adopted Plague did enter?—Yes.

3222. Could you give us some details of its entry into the city?—In spite of these precautions, infection was somehow conveyed into Bangalore, exactly how it has not been possible to ascertain, but from the fact that the first cases were among tranship coolies engaged in the city railway goods-sheds, and that the disease was at first confined to these people, their relations and neighbours, it is almost certain that the infection was brought from Hubli either by goods or by rats. In this connection it may be noted that wet hides were at that time being imported from Hubli side into Bangalore. There is evidence to show that some of these were stolen from the goods-shed by the tranship coolies and concealed in the house of one Mustan. This Mustan lived in a house opposite the one in Gowdenpet in which plague first occurred. The inmates of Mustan's house were also attacked five or six days later.

3223. You blame the railway considerably?—I do not blame it actually but that was the medium by which we got it into Bangalore. Another point for consideration is that the railway work-shop hands were the first to suffer, and that severely, as was the case at Hubli. Possibly these caught the infection by handling infected waggons. They also lived in the locality in which the disease first appeared. I have also a suspicion that simultaneously or a little later than its appearance in Gowdenpet, infection was brought from Hubli side by the friends of a railway guard living in a thickly crowded corner of Akkipet near the central parts of the city. It is well known that about this time subordinate railway employés were smuggling friends and relatives into different stations in the State. They used to evade inspection on the frontier station and the passengers were brought and placed above the station and then picked up again below the station. We have information that some of the people from infected houses escaped into Guntakal, the Collector telegraphed to us and we traced them to one of the infected houses. I traced it to two different centres. A railway guard was down with plague himself and this was detected about 22nd August, that is eight days after the first case was detected. But we have the suspicion that he was suffering before or simultaneously with the other case. Whether he was the first to be attacked or his relations and friends we do not know. But we detected the case in the guard's house.

3224. How was the smuggling accomplished?—We have the inspection at a particular railway station. A man is brought into the train by the railway employés either in the brake van or on the engine and just before the inspection station is reached he is dropped, and picked up again, after the inspection is over, down below.

3225. How many foci of infection were there?—I put them down as two, one at the Gowdenpet near the mouth of the railway goods-yard and the other a little way in the heart of the city at Akkipet.

3226. How did the disease extend from these places?—The scavengers employed in Gowdenpet were attacked, and they carried it to the Mysore Road Chattram. We put a police constable to guard the railway guard's house in Akkipet and he was attacked and took it to a place called Jali.

3227. And that became another focus?—Yes.

3228. You therefore have some four foci?—Yes; these were sub-foci.

3229. How do you account for the further spread?—By two agencies—by human agency first, and secondly by rats.

3230. With regard to the first foci how did you treat the cases; did you get early information of them?—We suspected the goods-shed coolies to be attacked, and we kept a policeman to watch. The policeman brought us information to say that there had been two burials in a particular burial ground. Suspecting these cases, because they were in such quick succession, we examined one of the corpses and found a sort of a swelling in the groin of one of the corpses of the children of the first house and we immediately gave information to the Medical Officer. On that information we examined the house and found some other cases of fever in it. This was on the 14th August.

3231. What was your action thereupon?—We immediately segregated the patients and took them into the hospital. We segregated the contacts and burnt all the rubbish in the house, knocked holes in the roof, and also in the side walls, and otherwise adopted all the precautionary measures laid down by the Regulations framed by the State.

3232. These measures were restricted to the houses in which plague had occurred, not to the neighbouring houses?—In the beginning they were restricted only to the houses attacked. We did not know the extent of the mischief then.

3233. Perhaps you did not recognise at that time the importance of removing from the neighbouring houses also?—Even if we had adopted it we could not have succeeded at that time.

3234. Why?—The people did not realise the necessity for evacuating those places and we should have had to use force with them.

3235. You think persuasion would have been insufficient?—At that time they did not realise the danger of living in an infected locality, and we should not have succeeded by persuasion.

3236. But even if you had employed force in the case of a few houses do not you think that it would have been justified if it was required to check the progress of the plague?—Yes, that was our object at the outset, to isolate these houses and cut off the spread of the disease from the other parts of the town.

3237. Do you think you could have evacuated the houses which were first attacked by using force without much serious

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consequence ?—No, we should have never evacuated them by force.

3238. Why ?—Unless of course we were prepared to resort to violence and the use of arms. We could never persuade them to evacuate the places. Even in segregating the Muhammadan houses to which I refer there was great opposition; the whole of the towns-people had assembled, and the Muhammadans in both the cantonment and the Peta had made common cause with these people, and there was great difficulty in segregating the patients and the contacts in that single house. Of course we had a little force in reserve, but we did not think it proper to use force at that stage. That being the case with regard to the segregated patients and contacts in infected houses, I do not think we should have succeeded without force in evacuating the locality round these infected places.

3239. Now will you kindly tell us how it spread ?—It was spread by human agency. From these places the disease spread rapidly, for in spite of all that was done to prepare the public mind against the highly infectious nature of the disease by the distribution of pamphlets and leaflets by the thousand, the people were careless and persisted in exposing themselves to infection. As elsewhere the dissemination of plague was largely due to concealment of cases and to the flight of contacts to evade detection and removal to hospital or camps. These measures, in spite of every effort to popularise them, were and are a source of horror and dread to the people.

3240. What were the probable agencies in the spread of the infection ?—Human beings and rats. We know as a fact that when plague got into Tharagapet, the principal grain mart of the city, rats became an important factor in the dissemination of the disease; they carried the infection into the adjoining streets and it was from this time that the mortality began to go up with a jump.

3241. Why do you say the rats spread the disease ?—I will not be sure about the rats communicating the disease, but this was the phenomenon noticed in these places, that simultaneously with the appearance of dead rats there were attacks in the houses.

3242. Have you any instances in which attacks in human beings followed the appearance of dead rat ?—Yes, we have instances in Siddicutta, a low-lying locality near the principal grain mart, of rats being found as many as ten in a house, immediately followed by plague attacks.

3243. What evidence have you that the contact of human beings spread the disease ?—We have the case of the policeman for instance. He was on duty in this infected house. We have the suspicion that he may have stolen some of the articles and handled them and conveyed the infection to his household, as the inmates of the house began to die one after another.

3244. No rats had previously appeared in this house ?—None that we know of.

3245. Are you quite sure that in the other house which you referred to there might not have been human contact ?—I will not be sure about it, but there rats were the prominent feature.

3246. You know of no case in which rats might have been the source of infection in which also you could disprove human agency ?—No.

3247. What kind of localities does the disease spread most rapidly in ?—Of course thickly populated localities were exposed to the plague attacks, but in addition, from my observation, the disease was generally severe in damp and overcrowded localities, though, as I say, in one instance in a small group of houses situated almost in the bed of the Agrahar tank there were only two houses attacked, and in others there were no cases at all.

3248. That constitutes an exception, but generally speaking it was in damp localities ?—That is so.

3249. And in overcrowded localities ?—Yes.

3250. What was the sanitary condition of the affected localities ?—Sanitation was very defective in all the localities.

3251. Can you tell me what sort of houses they were ?—Nearly all mud-roofed; there is a statement here showing the number of mud-roofed houses and tile-roofed houses. I think the mud-roofed houses are the predominant type in the city. The statement is as follows :—

Ward.	No. of Municipal Division.	Name of Municipal Division.	Terraced houses.		Tiled houses.		Mud-roofed houses.		Thatched houses.		Population.		Area in acres.	
I	I	Palace Division	78	302	253	350	178	2,234	249	250	5,120	20,663	2,261	2,885
	II	Balepet Division	224		97		2,056		1		15,543		624	
II	IIIA	Manavartepet Division	92	347	17	191	876	3,402	5	93	18,000	27,095	564	1,508
	IIIB	Ditto	125		56		1,582		32					
	VII	Fort Division	130		118		944		56		8,495		944	
III	IV	Cubbonpet Division		58		44		1,653		5		11843		124
IV	V	Nagarathpet Division	61	103	91	1,417	1,026	1,139	1	454	7,785	20,684	74	1203
	VI	Lal Bagh Division	42		1,327		113		453		12,899		1,129	
				810		2,002		8,428		802		80,285		5,720 or 9 sq. miles.

3252. How many chambers are there in these houses ?—It depends upon the size of the house.

3253. Are there not sometimes one and sometimes two chambers in the houses ?—Yes.

3254. What is the nature of the ventilation ?—The ventilation is generally by a hole made in the top, that serves for ventilation and also a chimney in the cooking portion of the house. There are small windows in the walls but only on one side generally, and owing to being close to other houses there is no free scope for air.

3255. As to light ?—Light is also admitted by these windows generally, and in some houses there are open yards round which these living chambers are built.

3256. The light is not good ?—No.

3257. The rooms are very dark generally speaking ?—Yes.

3258. Usually are there very many people living in one house ?—Yes, just before the outbreak of the plague we had made some extensions to the city to relieve congestion, but the whole city would cover less than two square miles and in this area about 80,000 people were living. To relieve the congestion we had opened out an extension in 1892, but with the influx of coolies employed on the railway and public works which were going on on a large scale there was a large floating population in the place; and this tended to overcrowd most of these houses. I knew in some cases rooms only 6 × 6 were occupied by a family consisting of four members.

3259. And they are the houses which chiefly suffered ?—Yes, especially in Gowdenpet where the plague first appeared the overcrowding was frightful. With regard to the room 6 × 6 to which I referred, there was only a small window almost an apology for a window, only for letting in air, for light there was none.

3260. As to the number of attacks ?—The following table gives the number of attacks each week in each ward.

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Week.	Ward I.		Ward II.		Ward III.		Ward IV.		Plague Camp.		Total.		Mortality from all causes.
	Attacks.	Deaths.	Attacks.	Deaths.	Attacks.	Deaths.	Attacks.	Deaths.	Attacks.	Deaths.	Attacks.	Deaths.	
August 12th to 18th	7	4	1	...	...	...	...	...	...	1	8	5	56
19th to 25th	7	2	3	...	...	...	...	...	...	4	10	6	49
26th to 1st September	...	...	4	1	...	...	...	...	...	3	4	4	64
2nd to 8th	5	1	3	...	...	...	1	1	...	4	9	6	70
9th to 15th	3	...	2	2	...	...	...	...	...	3	5	5	74
16th to 22nd	8	3	15	4	2	...	2	2	...	3	27	12	141
23rd to 29th	22	9	90	37	8	1	24	12	20	47	164	106	300
30th to 6th October	24	6	92	32	13	1	39	10	65	104	233	153	328
7th to 13th	61	24	132	45	25	3	43	16	100	150	361	238	551
14th to 20th	82	33	118	53	25	9	46	25	49	169	320	289	755
21st to 27th	91	36	69	29	64	28	48	24	25	142	297	259	773
28th to 3rd November	125	52	83	22	90	46	48	27	47	156	393	303	770
4th to 10th	126	61	48	22	115	65	56	19	44	155	389	322	748
11th to 17th	67	32	45	22	111	62	32	15	35	131	290	262	630
18th to 24th	53	81	26	9	134	83	36	16	40	103	289	242	503
25th to 1st December	37	14	19	6	87	45	18	6	25	78	186	149	342

3261. Now will you proceed to describe the measures which you adopted?—Yes, the measures adopted to check the pestilence were (*a*) segregation and treatment of the sick in Government Plague Hospitals. We had a large camp on what is called the Magadi Road and there we have both hospitals and contact camps. (*b*) The segregation by removal to camps of contacts and persons living in the infected houses. (*c*) The disinfection of infected houses with their contents. (*d*) The removal of plague corpses to the camp burial or burning ground. (*e*) The introduction of inoculation by Prof. Haffkine's method. Col. Benson will speak on this point. (*f*) Special attention to sanitary measures, and the opening out of the congested parts of the town involving the removal of nearly 1,600 houses. A tracing has been prepared which shows the new streets and conservancy lanes to be opened out. In addition to that we have marked another 1,000 houses for removal. (*g*) The construction of two large extensions covering an area of a thousand acres and providing accommodation for 50,000 people.

3262. That is being commenced?—Yes, it is proceeding now.

3263. How long do you expect it will take before it is completed?—We expect it to be completed within one year from now. They have taken up sites already. Two hundred sites have been taken up, and the other sites are being allotted daily and the extensions and roads are being laid out and also squares and public places.

3264. Are there any conditions relating to the sanitary state of these houses which you insist upon?—Yes; I insist upon ventilation and proper drainage and remedies for all the defects which have prominently come to notice during the plague.

3265. Do you make any provisions to prevent overcrowding?—We do. We propose by legislation to restrict people by superficial area, to say that a particular area shall not be occupied by more than a certain number of people.

3266. With regard to individual houses also?—Yes.

3267. You limit the number of those who shall occupy one single house?—Yes. The two large extensions covering an area of a thousand acres were started with a view to relieve congestion in the city; and were incidentally instrumental in affording relief work to numbers of the poorer artisan class, notably the weavers thrown out of employment and rendered almost destitute by the plague. (*h*) The next measure was evacuation of the infected locality and removal of people into health camps. This we did not succeed in doing on any large scale. Owing to the weather we were not very successful in keeping them in the health camps. I remember on one rainy night about seventeen families of tailors who had been removed from the city went back into the city from one of the health camps without giving notice to the authorities. The next measure (*i*) was provision by legislation for the thorough disinfection and sanitary improvement of deserted houses before re-occupation. There was a great exodus of these people when plague got spread in the city. They locked their houses up and left them without anybody to take charge of them, and such houses Government propose to take in hand, open them, disinfect their contents, and put them in a thoroughly sanitary condition. The Government has taken power to do this and we have started work already.

3268. Any structural alterations?—Yes, particularly in the way of letting in light and air.

3269. I think you find that people are now more willing to allow these structural changes to be adopted?—Yes. That is a very encouraging feature in this city. They appreciate the benefits of these improvements. In fact in the grain mart we have taken the shops and houses in hand, and the people themselves come and ask for holes to be made in the walls and roofs for ventilation, and also for letting in the sun.

3270. They appreciate the importance of ventilation and improved lighting?—Yes.

3271. And it is hopeful that they may afterwards voluntarily make these changes?—Yes.

3272. What is the administrative machinery?—For the execution of plague measures the city was placed under a Chief Plague Officer and divided into four wards, each in charge of an officer of the rank of an Assistant Commissioner assisted by a medical officer of the rank of an Assistant or sub-assistant surgeon, who, under the Chief Plague Officer was responsible for the detection of cases, for the removal of the sick and contacts to camps, for the disinfection of the infected house and their contents, and for the general sanitation of his ward. Later on, it was found necessary to break up wards Nos. I and II and place a portion of each under an assistant Ward officer assisted by a medical subordinate.

3273. In these arrangements I do not observe any provisions for house-to-house visitation?—I must explain that before plague appeared in the city we had a supervision system introduced in which the city was divided into different blocks and circles as we call them, and each block was placed under the charge of a supervisor. In March the town was divided into fifteen circles and fifteen blocks, each block under a Supervisor, and each circle under a Superintendent who was either a Gazetted Officer or a Municipal Commissioner. The voluntary system broke down; through their agency we used to get information about new arrivals and departures, and any cases of illness or death. These were reported to the Superintendent and the Superintendent reported to the President of the Municipality. By these means we had a check over illness in a house, and also, by means of a watch kept on the burial-grounds, any rise in the mortality was noticed.

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3274. You thereby obtained very early intimation?—Yes; we were watching continuously.

3275. Was the machinery which you have described effectual?—It completely broke down, except the watching at the burial and cremation grounds. The supervision system broke down completely when plague appeared.

3276. Why?—It was a voluntary unpaid agency, and many of the supervisors themselves were attacked with plague; we lost about five of them from plague by their going to the infected houses to get information. Of course there was a panic and the whole machinery was disorganised, and so we had to look to the paid agency of ward officers and sub-ward officers for dealing with plague when it actually appeared. The agency employed was the police, Municipal servants, the subordinates and the disinfection inspectors employed by the ward officers. In many cases the neighbours of attacked houses used to bring information to the ward officers, and on this information ambulance carts were sent to the infected houses.

3277. Was this last machinery effective?—No, it simply proceeded upon the information brought to it.

3278. You have no plan now of obtaining early certain information?—We have to organise machinery for bringing information from the systematic inspection of houses.

3279. Do you think that it is impossible?—We fear the people would resent house-to-house visitation. It is better to leave it to the usual machinery to get information.

3280. Did you employ any female supervisors, or only males?—We had nurses attached to each ward for visiting Gosha houses.

3281. But notwithstanding that you could not get a daily visitation?—No.

3282. What is the general effect of all these measures?—From the commencement the people manifested the utmost abhorrence to compulsory segregation and great difficulty was experienced in effecting it. As the plague increased in virulence, a small proportion of the population, chiefly Hindus, began to appreciate the advantages of segregation in camps, and treatment in Government hospitals. Of course, we had great difficulty among the Muhammadans; and even now there is a suspicion that more than half the cases are concealed by them. Now there is not the same opposition to going to hospitals and camps. There have been some recoveries in the Government hospitals, and people take more kindly to them than before. Still there is a little compulsion necessary even now. But when they once go to the hospital they appreciate its benefits. Before that they had a vague fear about hospitals generally. The measures hitherto adopted, taken as a whole, are very unpopular still, and even now there is concealment of cases owing to the dread of being taken to the camps.

3283. I think you have a statement to show the probable amount of that concealment?—Yes. It is as follows:—

	Total.	Daily average.
Deaths from all causes from 12th August to 30th November 1898	6,121	55·14
Deaths reported as due to plague for the same period . .	2,347	21·14
Difference .	3,774	34·00
Deduct daily average deaths of 10 previous years . . .	...	3·25
Deaths unaccountable except as due to plague . .	...	30·85

We may take it, therefore, that 30·75 deaths a day were concealed to 21·14 detected. The average daily mortality for the four months I deal with I take to be 3·25 and this is a very low figure, but our returns are avowedly very inaccurate, and it is only from the beginning of this year that an attempt was made to secure correct figures, both by improving the registering agency and also by posting people at the cremation and burial grounds to give us correct returns for burials and cremation. I think the mortality may be put down as 7 or 8 per day before the plague appeared. Up to the end of July we had very correct returns and the average was worked out at 7 or 8 per day. The average as given in the returns for the last ten years, works out at 3·25. Taking that as the daily mortality, out of a total daily average mortality of 55 cases the number brought to light is 21·14. And the extent of concealment is 30·75.

3284. You learn of these cases only after they die, I suppose?—Yes.

3285. With regard to those who do not die?—We have no means of finding that out; of course we get information from the neighbours and others.

3286. A great many must escape detection?—Yes.

3287. Your figures therefore understate the total number of the cases of plague?—This is not a correct statement—only the deaths. As a fact I have found that in some places there have been attacks even in inoculated persons, but they used to keep them from the authorities and there have been errors. Such cases were never put on the register.

3288. Of course there is great danger in this concealment of cases?—I have not heard of the concealment having tended to spread the disease, but on the contrary there have been many cases which were concealed from the authorities, but which by careful treatment in a separate part of the house under proper precautions recovered. I am referring now to the middle classes—the better classes. I have heard of instances among them, generally officials, who managed with the connivance of the ward officers to conceal their cases from the authorities. But they took the precaution of segregating the patient and treating him carefully, and there have been many recoveries.

3289. That was among the more intelligent part of the community?—Yes.

3290. And of course the concealment was not restricted to the intelligent part of the community?—No.

3291. Therefore in many cases concealment must have constituted a grave danger?—Yes.

3292. You found it so difficult to carry these measures into operation that you have made some modification, I understand?—Yes, this modification was adopted on the lines of the regulations adopted in Madras. The modification is that in an infected house, where the whole of the members are inoculated, neither the patient nor the inmates were removed, but every precaution was taken against spreading the infection to the neighbours and other people.

3293. What do you mean by every precaution?—We disinfect the house and also see that they do not come in contact with people outside. The people outside are not allowed to go into these houses, and the people inside are not allowed to mix with the people outside.

3294. How do you prevent them?—We keep a watch over the house.

3295. You have a watcher constantly there?—Yes.

3296. Day and night?—Yes. But even when the whole of the inmates are not inoculated we have extended the privilege of what is technically known as home-segregation to other people also who are not inoculated. But we take special precautions in such cases to prevent the spread of the disease, as I said, by keeping a watch at the house, disinfecting the house, and warning people from having anything to do with the inmates. This is not applicable to the city of Bangalore, but to the other cities and villages and towns in the State.

3297. You did not adopt that here?—No.

3298. What did you do here?—Here we worked on the same lines as in the Civil and Military Station. It is only when all the inmates are inoculated, and the house well prepared for a patient being treated in the house itself, that we allow the patient to be treated there.

3299. And if they are not inoculated?—We remove them to the camp.

3300. How is the disinfection of persons effected?—We used to pour the solution of disinfectant over them, bathe them in it, and then pour water on them and wash them.

3301. Further than that, when you disinfect you employ steam, I think, in certain parts of the town?—Yes. We had it at the City Railway Station. It was a combined system both for the city and the cantonment, and all those persons who wanted to leave the city were subject to disinfection, both of their person and their clothes, in the beginning, but latterly we do not disinfect the person; they are made to wash their feet in this solution, and their clothes are disinfected, and then only in the case of persons who cannot get a certificate exempting them from disinfection both for person and for clothes, that is, on the certificate of the medical authority of the ward.

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If he thinks they are respectable people and need not be disinfected we do not subject them to disinfection.

3302. I think the plague is extending in the surrounding district notwithstanding all these precautions?—Yes. I have a table showing the spread in the districts. They are mostly confined to the Bangalore district, and parts of the Tumkur and the Kolar district. The table is as follows:—

Taluks in which plague has become indigenous.	Date of first imported case.	Date of first indigenous case.	Approximate number of inspected villages in each Taluk.	Total number of indigenous cases up to 7th December 1898, for the Taluks.	
				Seizures.	Deaths.
1 Dodballapur	6th September 1898.	14th October 1898.	4	89	81
2 French Rocks	24th ,, ,,	10th November ,,	1	64	59
3 Kolar	,,	26th ,, ,,	1	1	1
4 Nelamangala	26th ,, 1898.	13th ,, ,,	3	26	16
5 Chikballapur	,,	29th ,, ,,	1	5	5
6 Anekal	27th ,, 1898.	5th ,, ,,	4	219	163
7 Malur	28th ,, ,,	28th ,, ,,	1	6	6
8 Tumkur	30th ,, ,,	10th ,, ,,	5	141	112
9 Mysore	2nd October 1898.	26th ,, ,,	1	12	3
10 Kankanhalli	3rd ,, ,,	30th ,, ,,	1	13	9
11 Bangalore	4th ,, ,,	12th October 1898.	22	82	68
12 Hoskote	6th ,, ,,	26th November ,,	1	26	19
13 Channapatna	12th ,, ,,	30th October 1898.	1	36	26
14 Goribidnur	13th ,, ,,	29th ,, ,,	2	56	54
15 Closepet Sub-Taluk	14th ,, ,,	18th ,, ,,	2	30	26
16 Megadi	16th ,, ,,	21st November 1898.	1	5	5
17 Devanhalli	16th ,, ,,	15th ,, ,,	1	3	3
		Total . .	52	814	654

3303. In any of these places would it be possible to clear out all the houses?—Yes, that is another peculiarity. They have taken very readily to it. The villagers are reported to have shown, and to be showing, a commendable spirit of self-protection and self-help, doing their utmost to keep plague out of their villages by preventing entry therein of any person from an infected place until he has been several days under observation outside the village; and on plague making its appearance in an epidemic form, by evacuating the village as rapidly as they can run up accommodation for themselves in their fields. There is a village watchman. He is kept at the village gate, and when he sights a stranger he gives warning to the towns-people by beating a tom-tom, and they turn out with spears and chase the man out in order to protect themselves—an old village system. They also show great readiness in camping out.

3304. Have you always succeeded in inducing them to camp out whenever the plague occurred?—Yes.

3305. In every case?—In a very large number of cases.

3306. What in your experience has been the result of this removal?—It has been attended with abatement of plague. There have been no more cases so far as the camping out is concerned.

3307. It is checked in that village entirely?—Yes.

3308. And that has happened in the case of several villages?—Yes.

3309. Then you have certain segregation camps?—We have. We have two hospitals and contact camps. One on the Magadi and one on the Mysore Road. The one on the Mysore Road was put up, but just as it was finished the plague went down and there was no necessity for using it. The former has an accommodation for 261 patients and 1,418 contacts.

3310. You have also some camps to which you remove the whole village, which you call health camps?—Yes.

3311. How many?—Seven.

3312. What is the total accommodation?—There are 530 sheds capable of accommodating about 3,000 people.

3313. They are huts I suppose?—Yes, they are capable of extension; there is plenty of ground about the camp. We have also materials brought from the Forest Department, and we give every facility to private persons to put up huts of their own.

3314. Have you a statement which gives us the number now occupied, and the castes?—Yes, it is follows:—

No.	Name of Camp.	No. of sheds		Thatch.	No. of sheds occupied.		No. of people of each caste living in them.		
		Mangalore tile roofed.	Zinc-roofed.		Zinc	Thatch.	Brahmans.	Muhammadans.	Other castes.
I	Basavangudi . .	...	50	314	18	54	...	54	229
II	Upperhalli . .	...	78	...	40	...	120	...	...
III	Mavalli . .	...	12	...	12	...	1 Family.	...	11 Families.
							(Making a total number of 43 persons.)		
IV	Mysore Road . .	...	30	...	7	...	...	34	...
(a)	Do Police Health Camp	50	.	...	5	...	...	...	
V	Chamrajpet . .	...	12	...	* 10	...	1 Family.	2 Families.	7 Families.
					Occupied by Town Police.		(Making a total number of 43 persons.)		
VI	Guttahalli . .	...	17	...	17	10	...	12	80
					Occupied by Reserve Police.				
VII	Jaksandra . .	...	.	17	...	...	16	...	61

Mr. V. P. Madhava Rao.

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3315. (*Mr. Hewett.*)—You have the same rules about evacuation in the city as in Bangalore Civil and Military Station?—Yes.

3316. When the whole of the inhabitants of a house have been inoculated, would you necessarily allow them to remain in it after a case of plague has taken place?—Not unless the house is a freely ventilated one.

3317. You do not let them remain in infected houses in the city except under these conditions?—No.

3318. Do you think that the watcher who is employed for the purpose can effectively prevent people from leaving an infected house?—We have not been able to test the efficacy of the system; it is not applicable, as I said, to the city.

3319. I suppose people would be able to get out whenever they liked?—We cannot prevent that.

3320. You leave them in infected houses, and have to trace them if they desert?—Yes.

3321. Why did the towns-people object to evacuating their houses?—Because there are so many interests, and so much property also.

3322. Was it because you put them in the segregation camp where they would be looked after and not allowed to do what they liked?—In the segregation camp they are more or less confined.

3323. In the villages the people simply go out into the camp, and they can go back to the village whenever they like, and into the infected houses?—Yes.

3324. And there is no system of disinfecting the houses? No.

3325. Therefore they can move about as much as they like although they are nominally in camp?—Yes.

3326. Are there any means of ascertaining who has got plague in these villages?—We have a flying column, as it were, put under the District Plague Officer, and we have also divided the work in the circles, and the supervisors go about from place to place and disinfect the houses according to the rules, in the villages.

3327. When the flying column comes does it detect all the cases of plague existing at that time?—Yes.

3328. What is the system of finding plague cases in the interval?—The report of the headman, and also the usual police agency.

3329. There is no medical agency?—Except that he goes with the flying column.

3330. Do the villagers insist upon all persons suffering from plague being put into a separate camp?—They do not like being put into camp.

3331. I mean when any body gets plague, do they turn him out into a separate set of huts?—They do not to my knowledge.

3332. Do the sick with plague live with the others in the camp?—Yes.

3333. There is constant contact between the sick and the healthy?—Yes.

3334. And the only thing likely to do good is the fact that they are in open well-ventilated huts instead of in their houses in the village?—Precisely.

3335. Is it very difficult to get an accurate record of sickness in the town?—They do not report voluntarily, and with regard to the Muhammadans, especially as far as the Gosha women are concerned, I do not think it is at all easy to get correct information.

3336. (*Mr. Cumine.*)—There were three chief foci of infection, I think. One in the part of the city inhabited by tranship coolies. That was one centre. Then it seems the sweeper got infected and went and set up a fresh centre. And a policeman got infected in the same way, and set up a third centre?—There are four centres; the first was the tranship coolies, and the second was the Railway guard in what is called Akkipet; the scavengers took the infection because they were scavenging the houses in the first infected locality. The policeman was on guard over the second locality and he started another series.

3337. The policeman, I think, was sent to escort the sick persons?—Yes, and also he was set to watch a house here.

3338. Do you think it probable that he may have gone into the house to get out the sick person?—Yes.

3339. So that he might have got the infection through the floor from his feet?—Yes; or he might have had something to do with the clothes and effects of the sick person.

3340. Then with regard to the tranship coolies, you have heard, I suppose, that the plague at Hubli was bad amongst the same class there, *viz.*, the coolies who worked in the goods-shed?—Yes.

3341. In an exodus from a town, when Brahmans run away, they would naturally go to Brahmans would they not?—Yes.

3342. And Musalmans to Musalmans and Mahrattas to Mahrattas?—Yes.

3343. And tranship coolies to tranship coolies?—Yes.

3344. Is there any connection of friendship or relationship between the tranship coolies in Bangalore and the tranship coolies in Hubli?—I understand the former are generally confined to Bangalore. There is not much connection between them.

3345. But do you think the Hubli tranship coolies probably have friends or relations in Bangalore?—It is possible.

3346. In the rains, do the villagers turn out readily? You said, I think, that the villagers were ready enough to evacuate sites. Would they do so in the rains?—No, of course it is not possible in the rains.

3347. You said that the villagers kept out strangers. But if the patel's brother or sister were to come, or the relations of some other big man, would the villagers have the moral courage to keep them out?—Not only that, but I have heard of the Revenue Officers being kept out, even the amaldars not being allowed to come into the village.

3348. With regard to the question of segregation, did you generally hear of a case while the patient was still alive, or did you generally hear of it only after the person was dead? Take for instance the case of the children who were supposed to have died of plague in the first known infected house, did you hear of the cases while they were alive?—No, long after they were dead, and the remaining children had left Bangalore.

3349. Did you hear of the man Chingalraya having run away until he had run away?—No, the man in whose house there were two deaths was named Kulla. He occupied one of the rooms you saw the other evening, and Chingalraya was the occupant of another room in the house. Chingalraya was the man who gave us the information about Kulla. He was the head of the family in the house first attacked, and he and his wife and his remaining children all had run away to the Madras side when we got the information.

3350. The stamping out of the plague in the beginning was rendered difficult by the fact that you generally heard of cases only after death?—Precisely.

3351. And when you came to segregate the contacts did you generally find that they were there, or had they gone?—They had generally left the place. We only got a small proportion of contacts, in fact Colonel Benson makes it out to be one and a decimal, whereas, estimating the family to have five members, it ought to be three or four. On the whole, however, we have got more contacts than elsewhere.

(Witness withdrew.)

MR. D. A. CHOKSI called and examined.

Mr. D. A. Choksi.

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3352. (*The President.*)—You are the Chief Plague Officer in Bangalore?—Yes.

3353. What are your medical qualifications?—Graduate of the Bombay University and Licentiate of Medicine.

3354. I think you are prepared to give us information about the plague in Bangalore city?—Yes.

3355. In the first place with regard to its origin?—I was not here at the time, I only joined on the 1st October. I was away on another duty at the time.

3356. You can tell us something about the steps taken with regard to plague?—Yes. We continued the system of supervision which we had introduced before the introduc-

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tion of plague, the removal of the sick to the Plague Hospital, the segregation of the contacts, the disinfection of the infected houses and their effects, and inoculation.

3357. With regard to the removal of the sick, how did you get information about them?—Our supervisors used to go from house to house, and they were supposed to give the first information; then the neighbours sometimes used to inform us. We often got information from the police; the ward officers themselves used to search and find cases.

3358. You were not here at the commencement of the epidemic?—No; I was here when the epidemic was at its height. The epidemic did not reach its height till after I joined.

3359. What are your ideas about the extension of the disease?—It spreads from house to house and from street to street mostly.

3360. The adjoining houses?—Yes, the adjoining houses.

3361. How do you think this is explained?—I attribute it chiefly to rats communicating the disease, and also to infected persons.

3362. Have you any proof that in any single case a rat has produced the disease in a man?—Not beyond the fact that dead rats had been observed in houses in which there were cases afterwards.

3363. Do you know that in these houses the persons affected could not have come into contact with another sick person?—There are many in which there was no evidence whatever.

3364. I ask you if you knew they did not come into contact with persons already affected?—I have enquired into many cases and I have found that the persons affected have had no possible means of contact with infected persons.

3365. Can you illustrate that by any example of cases you have inquired into?—I inquired into a case the other day, while going over the back cases, in which I found that a man who was affected in a particular street, and that was the starting point in that street, had no means of contact with any previously infected house.

3366. What were the circumstances which prevented his contact or intercourse with any other person?—He did not visit any affected house.

3367. To your knowledge?—Yes.

3368. Did he recover?—No, he died long ago; that is what I heard afterwards on enquiry of the ward officer.

3369. Is there any other example?—There is none I can remember now.

3370. What is the impression on your mind?—The general impression made upon my mind is that there have been instances in which people have been infected without coming into contact with other infected persons. I have not enquired of the infected persons myself, but I have learnt the history afterwards from the ward officers.

3371. What was the occupation of the man you have referred to?—He was a petty merchant.

3372. Where did he sell his things?—He had a petty shop in the bazar.

3373. That would be one of the best situations to come into contact with people?—Yes, but not decided contact.

3374. I should say that is a condition in which he would come into contact with people who might be able to convey infection?—I mean that he did not go into an infected house.

3375. What is your idea about the period of incubation?—I think it is within a week.

3376. How many days would be the minimum from what you have observed?—I should say 24 hours.

3377. You have seen cases where the evidence pointed to 24 hours as the period of incubation?—Yes.

3378. What has been the longest period?—I do not think more than a week.

3379. You know of no case where incubation has probably exceeded a week?—No.

3380. After the disease has appeared in a locality does it grow very quickly or slowly?—Slowly.

3381. The full development in your observation occurred generally within that period?—In a particular locality it takes about a week or even more. I say a week as the minimum, but perhaps it should be more than a week even in a particular locality.

3382. The epidemic in a locality reaches its height within what time?—It varies in different cases. I cannot say there is a particular rule about it; it depends upon the situation of the locality; I could say between one and three weeks.

3383. And it lasts?—It lasts fully two or three weeks, even up to four weeks in its full force.

3384. And the decline?—Takes another three or four weeks.

3385. It has a slow decline?—Yes, cases keep on occurring, one or two at intervals.

3386. What other circumstances besides those you have referred to—I mean personal contact and diffusion through the rats—appear to you to extend the disease?—The predisposing circumstances are overcrowding, ill-ventilation, ill-drainage, and bad lighting. The following figures will show the total number of houses in the city and the number of pit and conservancy privies in it:—

No. of Division.	Name of Division.	Total No. of houses.	No. of Pit privies.	Daily conservancy privies.	No. of pit privies converted into daily conservancy since about April 1897.	
I	Palace Division	768	396	72	...	The people of Dobbspet Pindurchery, etc., use public latrines.
II	Bulepet	2,378	1,790	600	400	
III	Manavarthpet	2,785	2,200	500	300	
IV	Cubbonpet	1,760	1,300	460	400	No. of houses with pit privies—8,191 Do. daily conservancy, do, 2,67 without privies. 1,17
V	Nagarthpet	1,179	800	350	320	
VI	Lal Bagh	1,934	1,680	250	200	Total 12,045
VII	Fort . . .	282	25	195	...	
	Western Extension . . .	966	...	250	...	No. of public latrines—50.
	Total	12,042	8,191	2,677	1,620	

3387. Do you find plague occurs among those who are in bad health?—No, except those suffering from starvation.

3388. You mean those who are weak from imperfect nourishment?—Yes, from want of food.

3389. What measures were adopted to check the disease?—As a rule removal to hospital. The contacts were segregated and the affected houses disinfected, and also the things in the affected houses. In cases where a number of houses were infected, and the locality was very badly infected, we attempted the evacuation of the whole. We have not succeeded in evacuating the whole locality.

3390. Can you give me an account of the result of each of these measures?—The removal of the sick and segregation of the contacts has led to concealment of cases because people do not like the idea of being removed from their houses and from their friends and relatives. The contacts also do not like to leave their houses to be taken to camp, nor do they like the disinfection of their houses. That has led to the concealment of cases, and the concealment

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of cases has led to the spread of the disease. In fact we found at a certain stage that the remedy, that is segregation and removal of the sick, was worse than the disease. Each case serves to make a centre for the spread of the infection.

3391. You did not get information early enough?—No.

3392. What is the result of disinfection?—So far as it was carried out the disinfection did succeed. Of course, we have no grounds to go upon as to how far it has succeeded in keeping off the disease, because most of the houses disinfected have not been re-occupied yet.

3393. So that it was only in conjunction with other measures that it was applied? It was never resorted to alone?—It has been resorted to, lately, alone. Our rules are relaxed, and we do not remove every person to the hospital, nor insist upon segregation if they are inoculated. Our rules are a little relaxed, and disinfection is the chief thing now carried out.

3394. What is the result of that?—We have not had a sufficiently large experience to form any conclusion.

3395. You have also had some experience of total evacuation of localities or streets?—We have.

3396. What has been the result of that?—Very decided, very good. I know of one or two instances in which small streets were evacuated, and people were made to go into the health camps, where there were only one or two cases of plague after that, and those within a week after evacuation. I will give, as an instance, the case of the Barr Sepoys, among whom there used to be half a dozen cases a day; after these sepoys were marched out into camps very few cases occurred.

3397. Is that in your district?—Yes, I had to direct the operation. The Barr Sepoys are an Infantry Regiment in Mysore. They used to have half a dozen cases daily. After their removal into camps the number of cases fell to one or two, and this only continued for about a week.

3398. Apparently only those who had already acquired the infection got it?—Yes, and that enables me to say what I have said as to the incubation period not extending beyond a week.

3399. Have you had any examples in the town itself?—Yes, there is one particular street, a very small street, in which we moved the people, who had suffered very badly immediately before the evacuation. We made the people go into health camps, and the cases fell.

3400. Before you removed the people cases were occurring in this street?—Yes.

3401. What were you doing before removal?—Removing each sick person and contacts only, the houses were disinfected and very few of these are yet re-occupied.

3402. Was the roof opened?—Yes, it was always opened.

3403. All these other measures were being carried out in this street, and the epidemic nevertheless increased?—It continued without abatement.

3404. Having removed all the inhabitants, what was the result?—We removed the majority of the inhabitants, and the result was that there were very few cases subsequently among those people.

3405. Do you know what the result was upon the surrounding locality, where evacuation had not been effected?—I think in the surrounding locality there was appreciably no effect.

3406. They had already been affected?—Yes, in fact cases had occurred there also.

3407. How did you accomplish the evacuation of the street?—By moral force more than anything else.

3408. Moral persuasion?—Yes.

3409. Did you do anything else?—We did not attempt it; we only used moral force.

3410. There is a good deal of difficulty in applying that method throughout the town?—Yes.

3411. What was the nationality of those people?—They were Hindus.

3412. There were no Muhammadans among them?—No.

3413. I understand the difficulty is the greatest with the Muhammadans?—Yes.

3414. Almost insuperable?—It has been hitherto; I hope we may be able to succeed in future.

3415. (*Dr. Ruffer.*) You said in some cases you had reason to believe that the incubation period was 24 hours?—Yes.

3416. Could you give a definite statement of definite cases showing an incubation period of 24 hours?—I do not think I can say definitely; it is only an impression.

3417. You told us the people objected very much to the disinfection of their houses?—Not so much as to segregation.

3418. But they object to disinfection?—They do.

3419. What part of disinfection do they most object to?—The removal of the roofs, and openings being made in the walls.

3420. Do they object to their houses being whitewashed or cleaned?—No.

3421. Do you think if some method were introduced by which the houses could be disinfected and the people replaced within a period of 2 or 3 hours, the people would have much objection to such a measure?—I do not think they would.

3422. You think such a measure would be easily applied?—Yes, it would be more kindly taken to.

3423. You say in the précis of your evidence that the houses are usually affected before the inmates; on what facts do you base this opinion?—The chief ground on which I make that statement is that rats are generally found dead in a house before the inmates are affected.

3424. Did you find dead rats before the people were infected in the city?—I was not here at the time.

3425. Your only reason is that the rats were found dead before the inmates?—Yes.

3426. You gave us some evidence as to a regiment in which the plague stopped after the regiment was marched out; was that regiment inoculated?—It was being inoculated, there were very few persons inoculated at the time they marched out.

3427. How long after leaving the town were they inoculated?—I am not sure of the exact date, but I think about two weeks. The majority were inoculated by the end of two or three weeks.

3428. Not before?—Not before.

3429. But you have no certain knowledge of that?—I am only speaking from memory. I believe the Chief Inoculator will be able to tell you.

3430. Then you told us about some houses from which the inhabitants were removed, and among whom very few cases occurred after removal. Did you refer to the whole street?—It was a very small street.

3431. How many people?—About one hundred.

3432. Could you give us the mortality in that street before and after evacuation?—I cannot exactly say the general mortality, but there used to be three or four cases every day.

3433. How many cases were there afterwards?—There were very few cases altogether reported—not more than half a dozen.

3434. Are you sure they all went into segregation?—Not the whole, but the majority of them.

3435. Who were left behind?—Some of their own community.

3436. The sick?—No, the healthy.

3437. Why?—They remained in their own houses; they could not be persuaded to go out.

3438. Who watched these people after they had been turned out?—There was an officer appointed, and also an officer to help him.

3439. But you do not know the exact mortality either before or after evacuation?—I have received the reports.

3440. Will you kindly give us that report, and also the number of people who remained behind, and the mortality among those people?—Yes. The figures reported *from* the health camp, I fear, include all the cases that occurred and not exclusively those among the tailors of Darzipetta. There is perhaps no record to distinguish them. The figures are as follows:—

PARTICULARS REGARDING EVACUATION OF DARZIPETTA IN NO. 1 WARD.

Population of the street before evacuation, 298.

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Date of attack, 1st November 1898.

Number of cases since—

	Cases.
1st November 1898	2
2nd „ „	*nil.*
3rd „ „	5
4th „ „	3
5th „ „	3

Between 1st and 5th, 150 people left.

On 5th and 6th, 87 people were sent to the health camp.

No case between the 5th and 15th. On and after latter date—

	Case.
15th November	1
22nd „	1
25th „	1
	None since

In the health camp, cases occurred as follows:—(all cases; not exclusively those among tailors of Darzipetta).

	Case.
7th November 1898	1
11th „	4
12th „	1
13th „	5
21st „	1
None since.	
	Total 12.

(Witness withdrew.)

LIEUT.-COL. P. H. BENSON, I.M.S., called and examined.

Lieutenant-Colonel P. H. Benson.

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3441. (*The President.*)—You are Senior Surgeon and Sanitary Commissioner to the Mysore Government, I think?—Yes.

3442. (*Mr. Cumine.*)—I will ask you first about the system adopted for trying to keep the plague out of Bangalore?—Prior to the outbreak of plague in the City the Darbar had instituted a system of careful medical inspection of all passengers coming from infected areas either by road or rail, and as Hubli was the nearest infected place a detention camp was erected at Harihar (the frontier station) and all passengers made to alight for the purpose of medical inspection, again at Yeswanthpur (a station just outside Bangalore) they were subjected to another medical inspection; and during their stay in Bangalore they were subjected to daily observation for ten days.

3443. In spite of that plague did get into Bangalore I think; the first case which was seen was that of David, a butler of Mr. Willans, was it not?—Yes.

3444. That man had come from Hubli?—Yes.

3445. He was taken ill almost immediately after his arrival from Hubli?—Yes.

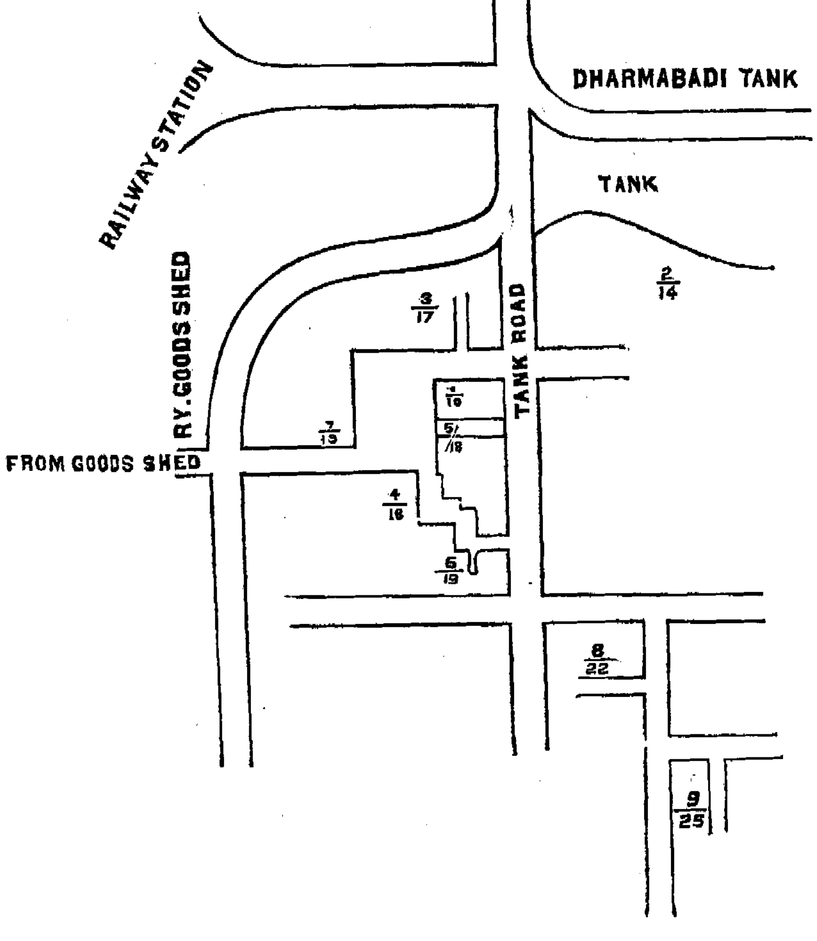
3446. But apparently he did not infect anybody else?—No, because he was at once segregated.

3447. The infection which spread was the infection which began among the tranship coolies working at the goods-shed?—Yes.

3448. I understand, from the statement you have sent in, that on the evening of the 13th Mr. Plumer, Officer in charge of the plague preventive measures, wrote to you?—Yes; he told me that two children living in Gowdenpet near the Madras Railway Company and Southern Mahratta Railway Goods-shed had died of fever on the 12th, and that the police constable on duty at the burial ground had noticed what he thought was a bubo in the groin of one of the corpses. The house is marked No. 1 in the ground map of houses in the infected area.

3449. You can put in a map, can you not, of the different infected houses?—Yes; it is as follows:—

ROUGH MAP OF ARLEPET
SHEWING INFECTED HOUSES



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3450. On the 14th you heard that yet another person was sick in the same house the two children had died in?—Yes.

3451. There were a number of families living in this house, I think?—There were three families.

3452. And some people had run away from it? —Yes.

3453. You heard that one or two of the runaways had died?—Yes.

3454. The remaining people in the house were removed to the segregation camp, I think?—Yes.

3455. Among those removed to the segregation camp, one girl was attacked?—The wife of the man who lived in the house was ill in the house, and that was what made them remove to the segregation camp.

3456. And after they had been moved to the segregation camp the girl got ill?—Yes.

3457. And then another girl named Rungamma also got ill in the segregation camp?—Yes.

3458. And the tenant who had been living in the house also got ill on the 14th?—Yes.

3459. The house was thoroughly cleaned out?—Yes, it was.

3460. This accounts for most of the people in that house, I think?—Yes.

3461. Then the next case was that of a woman found in a dilapidated house on the Arlepet Tank Road?—Yes, that woman was prior to some of the other cases; she was the third case.

3462. That would be House No. 2 marked in the map?—Yes.

3463. Had she been to House No. 1 to nurse any body?—Yes, she had been, and she was at the burial of the two children who were supposed to have died of plague, in one of whom the policeman noticed a bubo.

3464. On what date was her dead body found?—On the morning of the 17th.

3465. Then, in a house near, on the 17th you heard of a case of fever in a child attended with convulsions and accompanied with an enlarged gland in the neck?—Yes.

3466. And you believe that to have been plague?—Yes.

3467. That would be House No. 3 in the map?—Yes.

3468. Have you any idea how she got it?—No, they were different caste people.

3469. Their house is near house No. 1?—Yes, it is not 20 yards off, and in order to get out of their house they would naturally pass house No. 1.

3470. A number of cases then arose near house No. 1?—Yes.

3471. As if the infection was spreading from House No. 1 in some way?—Yes.

3472. In House No. 4 there was, I understand, the case of Govinda Rajlu and there was a woman, Rami. Her house was near the first infected area?—Her house was next to the one first infected. She was a tenant in a house adjoining the first house. The cases of Govinda and Rami were on the 18th.

3473. On the 19th two deaths were discovered in the infected area, one of the boy Mooniappa and the other a Muhammadan woman, named Towkal Bee?—That house is exactly opposite to the infected house, about 15 yards distant.

3474. That disposes of one centre of infection. Now there was the Railway Guard who came from Hubli, Narain Row?—He was infected in the 8th house on the 22nd. He had not been to Hubli, but he had been to Guntakal on the 22nd July.

3475. Was there no plague there then?—I do not think there was. There had been imported cases, but it was not declared infected.

3476. Have you any idea how he got it?—My impression is that he probably got the railway coolies to carry his kit and things to the station every day, and he might have passed on his way to his own house. I believe he got infected from those other people.

3477. Did he set up a fresh centre of infection? He did not live in the part where the tranship coolies lived, did he?—No, they set up a fresh centre in that part.

3478. Did cases occur in that part soon afterwards?—Yes, there was another on the 25th, a man who left his own house and went to another part and developed plague. From that house the man went to Guntakal and died of plague.

3479. Would you now please describe the further progress of the epidemic?—From the 24th of August to the end of the month there were five more attacks with six deaths, bringing the total number of attacks up to twenty-two and deaths to fifteen; giving a daily average of 1·1 and ·75 respectively, whilst the total mortality for the same period was ·158. During the early part of September the daily number of attacks remained much the same, being only fourteen for the first-half of the month, but from the 16th (when it became epidemic) to the 30th there were 213 attacks with 127 deaths.

The daily average number of registered attacks is 7·5
„ „ „ deaths . 4·6
„ „ mortality from all causes . 21·7

During the month of October the disease increased very rapidly and the whole town became thoroughly infected, as will be seen by the following figures :—

Daily average number of registered attacks is 44·9
„ „ „ „ deaths . 35·3
„ „ total mortality from all causes . 69·5

In November the epidemic may be said to have reached its maximum point, as on the 8th and 9th, 73 and 75 attacks were registered.

Daily average number of registered attacks is 43·7
„ „ „ „ deaths . 36·3
„ „ total mortality from all causes . 83·4

This does not go into detail, but it is sufficient to show what happened.

3480. When several indigenous cases had occurred and it was clear the disease would become epidemic, was the city divided into four wards?—Yes, each ward was under the charge of a Civil Officer, an Assistant Surgeon, and an Hospital Assistant with Supervisors under them, all of them being natives. The measures ordered to be adopted were :—1st, the early detection of all cases; 2nd, the segregation of the sick and those in contact with them; 3rd, thorough disinfection of infected houses by means of letting sun and air into them, and the destruction of the infective material by means of fire and germicides; 4th, where possible the evacuation of infected quarters. From the very commencement it was clear that compulsory segregation as a measure for arresting the disease was objectionable to the people, and large and numerous meetings protesting against it were held. Concealment of cases occurred almost from the commencement, but it was not until the epidemic assumed greater proportions, that they began to dispose of their dead by throwing them out of their houses at night, etc.; 15 dead bodies were found in locked up houses, and no less than 392 unclaimed bodies were found and disposed of. The result of segregation as a measure for arresting the plague has, on the whole, been quite as efficiently carried out (if not more so) in Bangalore as in Bombay and other places, for out of a total number of 3,115 registered cases of plague, 1,963 were sent to the Plague Hospital, and 3,601 to the contact camp.

3481. Please tell us about the camps; the measures generally, and the mortality.—In the contact camp there are 110 huts made of wood framework, roofed in with Mangalore tiles and good stout mat-walls, the cost of each being Rs. 120. They are capable of holding 880 contacts. The total number of contacts admitted up to 11th December is 3,601, the present number being 120. The largest number of admissions on any single day was 102 and the highest number present on any day was 755. Taking the population of the city at 85,000, and allowing a death-rate in normal years of 30 per mille, we get a total weekly mortality of 49. The total mortality from all causes in the city since the commencement of the epidemic is 6,121, from which must be deducted the normal death-rate, 847, leaving a total of 5,274. The total number of deaths actually registered from plague is 2,466, leaving 2,808 as undetected and concealed: in other words, only about 50 per cent. of the deaths due to plague were detected. Compulsory segregation in its old form has since been abolished with certain provisos. With regard to the evacuation of infected quarters, this has been in a great measure carried out by the people themselves, as it is estimated that about three-fourths of the population have migrated to other places, or are living outside the town in huts erected at their own cost. In the old city about nine-tenths of the houses are locked-up and deserted, and in the only part from which they have not yet gone the disease is still prevalent. Every effort has been made by the Darbar to

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encourage the evacuation of crowded quarters by the erection, on suitable sites, of health camps, and two large permanent extensions of the town are now being laid out and sites are granted to those who are able to afford to build: these when finished will bid fair to rival in size the present town, whilst the plan on which they are being laid out is one that will ensure against over-crowding in the future. A separate portion of each new extension is set aside exclusively for Muhammadans, which is undoubtedly a wise policy. Every ward officer has under him a staff of disinfecting inspectors, gang-men and a number of ambulance and corpse carts. The number of these has varied from time to time according to the amount of work. The establishment maintained at present consists of one European Officer, twelve Inspectors and about 150 gangmen, 20 ambulance and 16 corpse carts with bullocks, at an average monthly outlay of about Rs. 2,500. Mercuric perchloride, 1 in 1,000, is the germicide that has up till lately been used. As may be imagined, many villages in the Bangalore District are infected, in some the disease is indigenous, whereas in others only imported cases have occurred; the following table shows the different districts infected and the number of cases from the commencement up to the 10th December:—

		Imported.	Indigenous.	Deaths.
Bangalore	City	...	3,115	2,466
	Dist.	209	570	621
Mysore	City	13	17	17
	Dist.	19	70	79
Kolar Dist.		79	85	147
Tumkur „		55	146	157
Hassan „		2	...	1
Kadur „		5	...	5
Chitaldroog		6	...	4
Shimoga Dist.	...	...	...	...

The disease is, I fear, now indigenous in Mysore, which is the capital of the Province and where Her Highness the Maharani Regent and family reside. It has a population of 80,000 and parts of the town are densely crowded and in a very insanitary condition; so that prospects there are not very bright.

3482. Has inoculation been tried at all?—Inoculation was commenced directly the City was declared infected, which was in the first week of September. Mr. T. V. Armugam Mudaliar, M. B. and C. M., who had studied inoculation and plague preventive measures under Capt. Leumann at Hubli, was at once put in charge of those operations. Owing to the wild and unfounded rumours that were current among the lower classes as to the evil consequences of inoculation, it was only the educated classes who came forward at first. The majority of officers serving in the Mysore Government very soon set an excellent example by not only being themselves inoculated but also by having their families done. It was not, however, until about the third week of September that the people came forward readily for inoculation. From the 1st September to the 23rd 523 persons had been inoculated, whereas between 23rd and 30th no less than 4,163 operations were performed. So great was the demand for inoculation at this time that if serum had been forthcoming in sufficient quantity, I am quite convinced that as many as seven or eight hundred operations could have been performed daily. Unfortunately just about this time Professor Haffkine's supply ran short. The result of sufficient serum not being available was that a very great number of people ran away from the town who would otherwise have remained. The Darbar very early recognised the advantages of inoculation, for on the 4th of October they issued an order making it practically compulsory for all Government servants and those attending colleges and schools to be inoculated. The inmates of the Asylum and Central Jail were all inoculated towards the end of September, and have since been re-inoculated. The number of attacks amongst the lunatics has been five, of whom two died and three recovered. Of this number four were inoculated and two deaths occurred amongst them. The total number of inoculations performed in the jail is 1,219, of whom 697 were primary and 522 secondary. There have been two cases of plague, one in a prisoner sentenced to two years who had been in jail six months and was employed at making coir-twine for mats. He was inoculated on 24th September 1898, and died on 8th October 1898. The coir having come from an infected part of the town it was sent to the Government bacteriologist, who was able to isolate the plague bacillus from it. The other was an under-trial prisoner who, having come from a highly infected part of the Civil and Military Station, was not admitted into jail but kept in the observation shed on 1st November 1898. He developed symptoms of plague two days afterwards and died. The Sawar and Barr Sepoys who at first resisted inoculation were after some time persuaded to take it, and with the exception of the Barr Sepoys, whose lines were early infected, there have been very few cases. The total number of persons inoculated in the city of Bangalore is 23,537, of whom 21,537 are Hindus, Christians, etc., and 2,163 Muhammadans. Of the 23,537, 22,499 are primary, and 1,210 secondary. 194 attacks of plague are reported to have occurred amongst the inoculated, with 108 deaths or 55 per cent., but the number actually verified is only 109 with 66 deaths, or 61·5 per cent. Of the 109, 27 died within ten days after inoculations:—

1st day . .	...
2nd „ . .	1
3rd „ . .	3
4th „ . .	4
5th „ . .	4
6th „ . .	5
7th „ . .	1
8th „ . .	4
9th „ . .	2
10th „ . .	3

And 21 were attacked on the dates shown in the accompanying table, but the date of attack in the remaining six is not known:—

1st day after inoculation .	11
2nd „ . .	1
3rd „ . .	2
4th „ . .	...
5th „ . .	2
6th „ . .	2
7th „ . .	...
8th „ . .	1
9th „ . .	1
10th „ . .	1

In the town of French Rocks, with a population of 1,200, four hundred and fifty persons were inoculated shortly after the first case occurred, leaving 750 unprotected; of the 450 inoculated only two have died, whereas amongst the 750 uninoculated there have been 78 attacks and 69 deaths.

The Bangalore Woollen Mills employ as a rule about 900 hands, but on the outbreak of plague quite one-half ran away, leaving some 400 odd hands; of these 172 were inoculated. Out of this number three died of plague, whilst amongst the uninoculated there were 88 deaths. With the data available it is impossible to arrive at any correct opinion as to the immunity conferred by inoculation.

3483. Will you give us the details concerning the Plague Hospital?—Yes; 1,963 persons were admitted into the Hospital since the commencement of the epidemic; of these 1,261 died, giving a death-rate of 64·2, and 645 or 32·8 were discharged. Varieties: 47·1 per cent. of those admitted suffered from the bubonic variety. The glands most frequently affected are given below:—

Inguinal	315
Femoral	200
Axillary	190
Cervical	106
Sub-maxillary	70
Other glands	44

34·9 per cent. of admissions were of the septic variety, 1·5 per cent. pneumonic, and 2 per cent. abdominal. Castes: 1,683 were Hindus, 195 Muhammadans, 85 Christians and other classes. Plague mostly attacked those who on account of their poverty were badly fed, clothed, and housed. Five cases occurred among hospital servants, two inoculated and three not, and all of these died. Deaths: of the 1,261 persons that died, 166 died within 12 hours and 341 died within 24 hours, after admission. In the disinfection of persons, feeding of patients and disposal of the dead, caste prejudices of the

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various communities were respected, as far as possible, by the appointment of separate disinfection servants, cooks, food-servants, and corpse-bearers of the different castes. Separate accommodation was given to members of different castes as far as possible.

3484. With regard to the tranship coolies, do you happen to know whether they have any friends and relations in Hubli?—Not as far as we can make out; they may have friends, but they do not admit having relations there.

3485. Do you happen to know whether, during the exodus from Hubli, any tranship coolies from there or any people working near the Goods-station at Hubli ran away to Bangalore?—I have no definite knowledge on that point.

3486. You mentioned the case of a prisoner in jail who is said to have got plague from working at a piece of twine which came from an infected part. Had any of the warders already caught plague at the time?—Three died of plague but it was after that. The first death amongst the warders was on 30th October. He was attacked on 8th October. Of course the warders lived in the town, and they might bring infection.

3487. Is it known whether there had been any plague in their houses before this prisoner had been attacked?—There was no record of any case in their houses.

3488. Was this prisoner the only prisoner working at this piece of twine?—No, there were others.

3489. Did they get plague?—No.

3490. When the matting which this man made was finished, was he in the habit of taking it to the house of the person who ordered it?—No; it was made for sale. The contractor supplied the coir and stowed it in an infected house, and brought it to the jail as it was required.

3491. This man was engaged in making matting; was he the man to take it on to the person who had ordered it?—No, he was a prisoner and never went out.

3492. Did he work in the garden at all?—No.

3493. Do you know if there had been any cases among the police?—We have no police; we have our own jail guard.

3494. Consisting of warders alone?—Yes.

3495. When plague began first of all amongst the tranship coolies, did you have any opportunity of noticing whether there were any dead rats found?—There were dead rats found in the first house.

3496. That was after some people had died in it?—Yes.

3497. Did you notice whether dead rats were found in any other house?—Not just about then. In the Asylum dead rats were found.

3498. Can you tell us whether dead rats were ever found before the cases occurred, or whether the cases occurred before dead rats were found. Does the disease among rats seem to precede the disease among human beings?—It does not in a town. It precedes the infection of persons in a house, I think.

3499. When plague was first discovered in the city, was there any restriction placed upon the people attempting to leave the city and run away: was any pass required?—Yes, passes were given, but not at the very first.

3500. Had that the effect of keeping people back who would otherwise have run away early?—I do not think so.

3501. You do not think they were penned up?—No.

3502. (*Mr. Hewett.*)—Can you tell us the number of plague cases which occurred among the 3,601 cases who entered the contact camp?—Two hundred and fifty-six.

3503. How does that compare with the percentage of attacks among the general population?—It would work out at 7 per cent. I think the Hindus work out about 6 per cent.

3504. Forty thousand people left the City?—Yes.

3505. Leaving a population of about?—Forty-five thousand.

3506. Is not the rate of attack higher than 7 per cent. on a population of 45,000?—I do not think so.

3507. You estimate the deaths at 2,466 and 2,808 or 5,274?—I have never worked it out; I think I have worked it out amongst the Muhammadans.

3508. If you have a population of about 50,000, and 5,000 died from plague, it would be one in ten?—That population varied. They did not go out at any particular date.

3509. What I wanted to make out was whether the contacts suffered less than the people in the town; you have no clear facts as to that?—No.

3510. Have you any further details as to the occurrence of plague in the Lunatic Asylum?—Yes; the Medical Stores, which was the house adjoining the Asylum, is a part of the same building. Dead rats were discovered in the Medical Stores on the 15th October. On the 31st October a man named Shaikh Hyder, a lunatic, who was employed in disinfecting the stores, was seized with plague. On 1st November another lunatic was attacked with plague. On the 2nd November another, on the 8th another, and on the 9th another.

3511. That is five cases in all?—Yes; since then there have been none.

3512. Was anybody employed in the Medical Stores besides the lunatics?—Yes, there is an Assistant Surgeon and two to three writers.

3513. Are there any warders?—Yes. They look after the lunatics while they are working in the Stores. We have had one warder and one warderess. The warder died on 12th September, not inoculated, and the warderess on 9th December, both prior to the others.

3514. Then the death in September was before the rats were observed in the Stores?—Yes.

3515. We cannot draw any deduction from that?—No, I do not think so.

3516. You give the total of inoculated persons in the City of Bangalore as 23,537, and you say that 194 attacks of plague are reported to have occurred among them?—Yes.

3517. May there not have been a great many more than that?—Yes, there may have been a very large number more. These were the only cases we know of.

3518. You verified 66 deaths?—Yes.

3519. And that 109 persons were actually attacked?—Yes.

3520. And you are unable to say that either the number of attacks or the number of deaths are in any way complete?—That is so.

3521. I suppose a number of inoculated went from the town as well as the uninoculated?—Yes, but not so many, I think. When they are inoculated, they do not run away so readily.

3522. Is it not very difficult to ascertain whether a person who is dead has been inoculated, especially when you have such a large number of bodies thrown out as were thrown out in Bangalore City?—Yes. There may have been a great many more.

3523. Some of the bodies which were thrown out may have been those of inoculated persons?—Yes. I think there are other facts in connection with inoculation which prove its value.

3524. In the town of French Rocks 450 persons were inoculated, and only two have died?—Yes.

3525. Among the 750 persons uninoculated there, there have been a number of cases and deaths?—Yes, 78 cases and 69 deaths.

3526. Do you think that these figures are accurate?—I think it is accurate; I was there myself last Friday.

3527. Will you tell us why you consider that these figures are more accurate than the others?—Because it is a small number.

3528. You have the people of the town of French Rocks isolated to a certain extent?—They are all in camps, except about 30 or 40 living in the town.

3529. Under close observation?—Yes, the medical officer goes round every day.

3530. And you have been there yourself?—Yes, I inoculated 45 the other day myself.

3531. Even if it is the case that more than two of the inoculated have died, do you think that there has been so great a difference between the way in which the plague has affected the inoculated and uninoculated, respectively, that there is very fair evidence that inoculation has been protective?—Yes, I think the evidence is distinctly in favour of inoculation.

3532. Can you tell us how many attacks there were among the 450 inoculated persons?—Only two.

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3533. Can you give no figures as regards the Bangalore Mills ?—There were 172 persons inoculated and about 228 left uninoculated.

3534. I suppose these men are under strict observation ?—Yes.

3535. And only three deaths from plague have occurred among the inoculated ?—That is so.

3536. Do you know how many of the inoculated were attacked ?—No.

3537. Do you know how many were attacked among the uninoculated ?—No, I can get those figures. (Witness subsequently stated that he was unable to give any figures in addition to those he gave in his evidence.)

3538. The general effect of inoculation is favourable in your opinion ?—Yes.

3539. I think you have some figures which you received from Mr. Vanes, the head of the Wesleyan Mission, which give the results of inoculations among the Wesleyans ?—Yes. This is the letter from Mr. J. A. Vanes of the Wesleyan Mission :—" During the plague we have had living on this side of the Petta 182 Native Christians belonging to our church. Amongst them are 43 girls in our Boarding School. Of these 182 there were 81 inoculated once. A full month after inoculation two were attacked with plague and they both died. Ninety-five were twice inoculated and none was attacked; six were not inoculated and of these three died certainly of plague. One died, but it is uncertain whether it was a case of plague. One died, but certainly not of plague ; remaining one is at present in the plague camp suffering from the hæmorrhagic form of the disease."

3540. Will you find out why those six were not inoculated ; the reason is not stated in the letter ?—Certainly. [Witness subsequently communicated a letter from Mr. Vanes as follows :—" The reason these 6 were not inoculated was as follows :—Three were too old, 1 was too busy (a servant in the Lunatic Asylum), 1 was suffering from whitlow (she has now died), and 1 was indifferent and at the time escaped my notice. One of those who were too old was certified to have died from asthma and bronchitis."]

3541. With the data available you say, " It is impossible to arrive at any correct opinion as to the immunity from inoculation ; " is not that somewhat inconsistent with your other evidence ?—I meant more with regard to the total number of inoculated, 23,000.

3542. Perhaps it will be well to explain that you were referring there to the effect of inoculation on the total city population inoculated, namely 23,000 ?—Yes.

3543. (*Dr. Ruffer.*)—In your evidence you say that eleven people died on the first day after inoculation ?—In verifying these cases we find that it is so.

3544. Do you know of any reason why the majority of cases dying after inoculation should die on the first day ?—I know no reason except that they were infected.

3545. You think it was because they were infected ?—Yes.

3546. Then in your evidence in dealing with the case of the Bangalore Woollen Mills you say " out of this number three died of plague, while among the uninoculated there were 88 deaths "; I think you mean deaths from plague ?—Yes.

(Witness withdrew.)

MR. M. SRINIVASA RAU called and examined.

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3547. (*The President.*)—I think you are the Chemical Examiner and Bacteriologist to the Government of Mysore ?—Yes.

3548. Will you state your medical qualifications ?—I am a Bachelor of Medicine and Master in Surgery and Bachelor of Science of the University of Edinburgh.

3549. (*Prof. Wright.*)—You have made a study of the bacteriology of plague ?—Yes.

3550. Have you any facts as to the channel through which plague enters the body ?—No.

3551. Have you any experiments as to the channel by which the plague bacilli leave the body after they have once gone in ?—Yes.

3552. Have you any experiments, for instance, on buboes ?—No.

3553. Have you any experiments as to the bacteria leaving the body in the sputum ?—I have examined samples of sputum.

3554. Did the sputum which you speak of come from the bubonic cases or from the septicæmic cases ?—I did not inquire. They were sent to me from the plague camp.

3555. Then you have no facts bearing on the point whether an ordinary bubonic patient has got an infected sputum ?—No.

3556. Have you any facts bearing on the urine ; do the bacteria leave the body in the urine ?—Yes.

3557. Will you describe your experiments ? How many samples have you examined ? —I examined eight samples and I have now examined four more samples.

3558. In how many cases out of these eight did you find plague bacilli ?—Five.

3559. Do you know what cases the urine came from ?—No ; they were all suspected cases of plague and they were sent to me, whether they were real cases of plague or not.

3560. Do you think we may infer that a great number of plague patients have got bacilli in their urine ?—I should think so.

3561. Have you had any definite information as to when plague bacilli appear in the urine, and as to when they disappear from the urine ?—So far as I know, the bacilli in the urine appear mostly just before death, or a few hours before death.

3562. Have you facts which establish this ; you state that you do not know the derivation of these samples ?—Afterwards when I made enquiries in the plague camp as to who these patients were I was told they had died a few hours after their urine was taken, in some cases a day or two after.

3563. So far as your facts go, they prove that there are probably bacteria in the urine shortly before death ?—Yes.

3564. Do you know anything of the presence of bacilli in the fæces ?—Yes, I examined four cases and in three I isolated plague bacilli.

3565. Do you know from what patients these samples were taken ?—Yes, all the samples were taken from those from whom I got the urine.

3566. You do not know exactly from what kind of cases these samples of fæces were derived ?—No.

3567. I understand that in a few of these cases you will be able to tell us what patient they came from ?—Unfortunately I did not bring the detailed notes of all cases, but in the case of Mr. Willans' butler I took the urine about two days before death.

3568. In the case of the others will you look to the details of your notes and send them in ?—No details were sent in to me.

3569. Perhaps in conjunction with Colonel Benson you may find out the derived history of the patients who furnished the fæces ?—Yes, I shall try. [Note by witness on correcting proof of his evidence :—I made enquiries in the plague camp, but as no clinical history of the plague patients has been kept there, I regret I cannot give the details required.]

3570. Do you know of any other way in which the bacteria can escape from the patient into the outer world ? Do you know, for instance, whether fleas or other parasites are able to take out the bacilli from the blood ?—I do not know.

3571. Do you know whether the plague bacilli can pass alive into the outer world from the corpse after death ? Do you know whether they survive in the corpse after death ?—I have not made any experiment.

3572. Have you made any experiments to see whether fæces or urine are actually infective ? Do you know whether animals can be infected by these ?—No.

3573. Will you describe the method by which you were able to find the plague bacilli in the urine ?—Yes.

3574. Did the urine you received contain the plague bacillus in pure culture ?—No.

3575. It contained other bacteria ?—Yes. Although I sent sterilised bottles, I think the urine was first passed into an unsterilised bottle. When I went last time myself, I had the urine passed directly into the sterilised bottle.

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3576. Will you describe your method of isolating plague bacilli?—I take a reducing solution as follows:—

FeSO4	10	grammes;
Tartaric acid	10	"
Citric acid	5	"
Distilled water	50	c.c.

this solution to be made alkaline with ammonia. Then I take a set of tubes containing about 10 c.c. of bouillon in each. One I keep as a control; to the rest I add varying quantities of this solution from one drop to about 12 drops and then about a half c.c. of urine to each of these tubes, keeping the whole of the tubes incubating for 24 hours. Then I examine the condition of the tubes and select those tubes in which the colour of bouillon is not quite discharged and there is a very slight flaky precipitate at the bottom. From the selected tubes I make cultures into slanting agar tubes.

3577. Are any of these tubes pure cultivations of plague?—No, I have never found the pure culture. Then from the tubes in which the characteristic growth of the plague microbe is noticed, I make pure cultures into other tubes, and if I am not satisfied, I make microscopic specimens and inoculate them into mice and see what the effect is. Again I isolate the plague bacilli from the spleen of the mice. I have also studied the stalactitic appearance of the growth of the plague bacilli in the bouillon flasks.

3578. Did you go through the whole of that process in each case?—No.

3579. You went as far as obtaining the pure culture?—I inoculated the mice, but did not proceed to get the stalactitic growths in bouillon flasks.

3580. In each case you got pure culture of plague and then you inoculated mice and saw that they died?—Yes.

3581. Have you any experience to show how plague may get into animals and how they can be infected by it; can animals be infected by the mouth?—No.

3582. Can they be infected by hypodermic injection?—Yes.

3583. Any other method?—No.

3584. Have you made any experiments to show whether the plague rapidly spreads from one animal to another; have you kept an infected rat with other non-infected rats?—No, I kept two rabbits together and one of them accidentally got infected, and the other died afterwards.

3585. Did it die of plague?—Yes, but it was accidentally infected.

3586. Were the two rabbits kept very close together?—Yes.

3587. Did the first rabbit die?—Yes. I found it died of plague, and a few days afterwards the second died also of plague.

3588. Is that the only observation you have bearing on the infectivity from animal to animal?—Yes.

3589. Could you tell us what animals you have found to be infected with plague; you say that you have found plague-infected rats?—Yes.

3590. I understand rats died in large numbers during the plague epidemic?—Yes.

3591. Have you examined a considerable number of these rats?—Yes, about 38.

3592. In what percentage of these did you find plague?—In about 22 rats out of 38.

3593. Have you seen plague in mice?—Yes.

3594. Do they die spontaneously during the plague epidemic?—Yes.

3595. Has the mortality been very large among mice?—We have many cases. I have dissected ten mice and found they all died of plague.

3596. You speak also of plague among bandicoots; do bandicoot haunt houses?—Yes.

3597. What about squirrels?—I have examined a number of squirrels which dropped dead from the houses.

3598. Are they liable to convey infection; do they haunt houses?—They are found on trees in the compounds of large houses.

3599. But then squirrels are not sufficiently tame to go into houses?—No.

3600. You said you found plague in rabbits; was that only in rabbits you kept artificially?—Yes.

3601. What about cats; have you found plague to occur in cats?—I examined one cat, and there were no plague bacilli in it. I examined one deer which was brought to me that had died of plague.

3602. Do you know of dogs becoming infected with plague?—No.

3603. You have not heard of any?—No.

3604. I suppose you surmise the plague bacilli get out through the urine and fæces of animals?—Yes.

3605. And that they can be thus scattered about in the external world?—Yes.

3606. Have you determined how long such plague bacilli survive in the external world?—I have tried in the urine and the fæces artificially infected, and seen how long they survived.

3607. What is the longest period in which you have found plague bacilli lived in the urine?—They were not dead even after 24 hours.

3608. Were these plague bacilli freely exposed to the air?—No.

3609. These experiments did not represent then the circumstances which actually occur in nature?—No.

3610. Have you made experiments with respect to the vitality of plague bacilli in the fæces?—Yes.

3611. How long do these plague bacilli live?—Two and a half hours.

3612. You have never found them afterwards?—No.

3613. You think fæces are not likely to infect?—Not to such an extent as urine.

3614. Do you know whether the plague bacilli are killed when the urine evaporates and dries up?—No.

3615. Have you examined any materials which were infected by plague, I mean naturally, not artificially?—Not artificially infected. In the case of the coir which was sent to me from the jail, I believe that was naturally infected and not artificially, and I found the plague bacilli in two cases.

3616. Did you find where the infection came from?—No. I was told that the coir was brought from an infected house, and that a convict who had worked with it died of plague.

3617. What is the history of the coir that gets into prison; is it used for any purposes before it goes in?—I do not know.

3618. You did not try to trace how the inoculation got into the coir?—No.

3619. Have you ever found the earth naturally infecetd?—I have tried to isolate the plague bacillus in many cases, but I have never succeeded.

3620. Were the samples of earth which you dealt with full of all sorts of bacteria?—Yes, I examined seven samples of earth.

3621. In view of the fact that you succeeded in finding the plague bacilli in the fæces which contained many other bacteria and that you failed to find it in earth which contained many other bacteria, do you think you have the right to infer that the earth was not infected?—I cannot say it was. Only the bacteria I found in the earth were not killed by the solution I used in the fæces.

3622. I only want to know whether you think you would be able to find a small amount of plague contamination if it was present in the earth, or do you think that your method is not good enough for this purpose?—I should think so; if it was sterilized, and I then infected the earth with only two or three kinds of microbes along with the plague bacilli, I might then be able to isolate the plague bacilli. But the ordinary infected earth contains innumerable other microbes, and that is the real difficulty.

3623. Have you examined any other articles which were naturally infected, any clothing?—In one case the clothing which was infected with the fæces of a patient was sent to me and I found the plague bacilli in the fæces.

3624. That was visible and grossly contaminated?—Yes.

3625. Have you examined any clothing which was not grossly contaminated?—No.

3626. Have you made any experiments by artificially infecting the clothing?—No.

3627. I think you have made some experiments on germicides?—Yes.

3628. What germicides have you experimented with?—With electrolysed water containing chlorine and hypochlorites in solution.

3629. Is that made from sea water?—No, ordinary water with 3 per cent. of sodium chloride.

3630. It had been freshly prepared?—Yes.

3631. Have you experimented on water kept for a number of hours?—Yes, after 24 hours and after 48 hours.

3632. Did you find considerable germicidal power in freshly prepared electrolysed water?—Yes.

3633. Was it very much diminished after 48 hours?—Yes, but still it was to a certain extent germicidal. I found the number of bacteria reduced.

3634. You say you sterilized the earth in plague houses?—Yes.

3635. That means you killed all the bacteria, and all the spores?—Yes; after 48 hours there was no growth to be found in the agar tubes.

3636. Can you tell me exactly how you did the experiments?—It was an actual plague-infected house. I had the floor dug up and then thoroughly soaked the whole ground with the disinfectant and then examined samples of earth every half hour. I took small quantities of bacteria, made cultures on tubes, and found that the number diminished, and at the end of the hours the earth was quite sterile.

3637. You made your cultivations on agar tubes with a needle which you infected from the ground?—Yes.

3638. Do you think you carried with you some antiseptic from the ground?—Even supposing I carried some of the disinfectant, it would soon evaporate.

3639. Did you use any considerable amount of earth for these experiments?—No, just as much as I could take on the loop of the needle.

3640. Did you take this earth from the upper portion?—From different portions.

3641. Did you try this chlorinated water also on walls or anything that had lime in it?—No, not on the walls, but only on floors.

3642. Do you think you would have a great diminution of bactericidal power if you put it on walls which are full of chalk or lime?—I have never made any experiments.

3643. Have you experiments with any antiseptics?—I have, with a patent antiseptic which was sent to me for the purpose of analysis—pineoline. It was sent to me on the 25th November, I do not know whether it would be right for me to mention it.

3644. Your experiments are not ready?—Yes, they are ready.

3645. Are we not to have them?—I hardly think so. I also tried Law's fluid.

3646. Is it in use?—I do not believe it is, but it was sent to me.

3647. (*Dr. Ruffer.*)—I understood you to state that the urine sent to you might have been placed in an unsterilized vessel before being transferred to a sterilized vessel?—Yes, in those cases in which I took the urine personally I have no reason to suppose that.

3648. In how many cases did you take it?—In four cases.

3649. And in those four cases you found plague bacilli?—No, in two only.

3650. You are perfectly certain there was no contamination?—Yes.

3651. The fæces which you examined came from the same patients as the urine?—Yes.

3652. You told us how you tested for the plague bacilli in these substances, but you did not explain how you tested the matting; did you examine it in the same way?—Yes, in the same way.

3653. That is, passing it through mice and making cultures?—Yes.

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3654. What are the most characteristic points in plague cultures?—They are better understood than described. It has an almost hazy transparent appearance; it is not quite white or opaque, but almost hazy.

3655. When you made cultures from the spleen of these mice, how did you satisfy yourself that you were really dealing with plague microbes?—I examined them under the microscope.

3656. And on agar?—Yes.

3657. And on gelatine?—Yes.

3658. Can you give us any evidence with regard to involution form?—No.

3659. Or to plague bacilli liking a large amount of salt?—I was trying to make experiments in Bombay but I have no facts.

3660. When you mix the earth with a certain amount of this electrolysed water, you get it to act on all kinds of bacteria?—Yes.

3661. You say you tested these by making cultures on agar?—Yes.

3662. Do you think that gives you a fair idea of the action of the disinfectant on all kinds of micro-organisms?—No. Only on ærobic microbes.

3663. So that the evidence you bring forward as to the action of electrolysed water would be only on ærobic microbes?—Yes, and the plague microbe is an ærobic one.

3664. How much free chlorine did the electrolysed water contain?—I have not tested that.

3665. Have you any idea?—No, I have not.

3666. I think you made some experiments as to the behaviour of the bacilli in milk? Can you give us some details?—I examined twelve samples of milk. The first thing was to take the re-action, and the re-action was almost always amphoteric. Then I sterilized it in tubes and afterwards infected it with plague bacilli. I then examined how long they could live. In some samples I left the milk standing for 24 hours until it became quite sour and then tested it. I found in the fresh milk, with amphoteric re-action, the bacteria did not die even after 24 hours. In the case of the alkaline milk also the same thing was noticed. But in the case of the sour milk I found the bacilli were killed in one hour.

3667. So that from a practical point of view, you think even if the milk were artificially inoculated with plague bacilli, there would be no danger?—No, not if the milk were allowed to become sour.

3668. Under ordinary circumstances would milk become sour?—Yes, if it is left for 24 hours.

3669. Did you make any experiments with grain?—I made some 12 sets of experiments on rotten grain and mixed it with water and allowed it to decompose for 48 hours, and then took the extracts from the decomposed grain. I took rotten grain extract and sterilized it in test tubes, and afterwards inoculated it with plague bacilli. I found in most cases the re-action was acid. I found that in all those cases the plague bacilli were killed in one hour.

3670. You made your experiments on rotten grain which had been sterilized?—Yes.

3671. Have you made any experiments on rotten grain which has not been sterilized?—No.

3672. Do you not think that that would be a practical way of doing it?—Yes, if I had stayed longer in Bombay, I would have done it.

3673. (*The President.*)—Are there any food substances which you have examined in the same way?—I have examined some ordinary rice, but I was not able to isolate the bacilli.

3674. Did you examine butter?—No.

(Witness withdrew.)

Mr. P. R. Cadell, I.C.S., called and examined.

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3675. (*The President.*)—What is your present duty?—I am Assistant to the Resident on Plague Duty.

3676. (*Mr. Hewett.*)—You were employed at Karachi during the first epidemic in 1897?—Yes.

3677. What is the population of Karachi?—By the census of 1891 it is 98,000.

3678. It is probably a few thousands more now?—Yes.

3679. The plague began there in December 1896?—Yes.

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3680. You were not there at the beginning?—No, not till January.

3681. When did the epidemic reach its height?—About the second week of February, and from that time it declined regularly till the end of March.

3682. It took a long time before it finally died out of the town?—Yes, July 27th.

3683. In the early stages only methods of persuasion were used?—Yes.

3684. Did you simply invite people to leave their houses?—They were invited to send their sick to the Government Hospital.

3685. Did they send them to the Government Hospital?—No.

3686. They kept them in their houses?—Yes.

3687. And during the time that that process was in operation, do you think that the plague was more virulent than when you adopted different measures subsequently?—I think it spread more steadily; I do not think it went so fast afterwards.

3688. Why should it go more steadily, but not so fast?—I mean the death-rate did not go up so high so quickly.

3689. The people were kept in their own locality?—They were encouraged to leave the infected locality, and the result was that in all probability they went to other localities of the town—those who did not leave the town altogether; the majority left the town altogether.

3690. I do not quite understand what you mean?—I am comparing it with the second epidemic in 1898.

3691. The circumstances of the epidemic were different then, were they not?—Yes, but I cannot compare it with anything else.

3692. May it not have been a more virulent epidemic the second time, quite apart from any of the measures?—Yes.

3693. Can you tell us what was the system introduced when you gave up measures of persuasion?—Compulsory removal to the sick hospital and compulsory segregation.

3694. Were people segregated in camps provided by the Government, or did they provide them themselves?—The camps were provided by the Government.

3695. Did they resort to private camps?—No, there was a large camp made for one of the sects of the people, a large body of Hindus, which they were allowed to manage themselves, and there were some others. A good number of people went to live 8 or 9 miles out of the town.

3696. Have you any facts to show how the people in the camps got plague?—No.

3697. Do you think that in the early stages of the disease whole families were obliterated in a manner not found when you took preventive measures?—Yes.

3698. Can you give instances?—I know of one family in which there were eight deaths, and I have known of a compound of three houses with thirteen deaths out of eighteen people.

3699. That is your general impression?—Yes.

3700. Were all the houses in the badly infected quarters disinfected?—Yes.

3701. Can you say how they were disinfected?—Perchloride of mercury was used for the walls and floors, and then the walls were lime-washed.

3702. Were people allowed to re-occupy them without any permanent sanitary improvement having been effected?—Yes.

3703. Do you attribute the re-infection of the place to that?—No.

3704. You do not say that the disinfection was inefficient?—No, I mean that after a considerable space of time the improved cleanliness of the town did not operate to check the spread of the disease on a fresh outbreak.

3705. But the insanitary surroundings remained the same, did not they?—The defective drains remained.

3706. And the construction of the houses was not altered?—Not to any great extent. We did what we could in the way of letting in new windows.

3707. There was nothing to arrest the epidemic when infection came for the second time beyond the fact that the houses had been disinfected?—No.

3708. Did the people leave Karachi at the beginning of 1897?—Yes, in large numbers.

3709. By road or rail?—By rail and sea, chiefly.

3710. A good many went to Cutch Mandvi?—Yes.

3711. And Cutch Mandvi shortly afterwards became infected?—Yes.

3712. Is it your opinion that the infection in Cutch Mandvi went from Karachi?—A great many infected people went from Karachi.

3713. Was that the general impression in that part of the country?—I believe the Cutch Mandvi people believed they got plague from Bombay.

3714. Some of the people leaving Karachi would have to go a certain distance by desert?—Yes, through uncultivated country.

3715. Were those who went by rail carefully inspected on the railway?—Yes, they were carefully inspected at Karachi on leaving. The chief inspecting places were at Karachi, Sukkur and Jacobabad. There was inspection at some other places also.

3716. Did you make arrangements for European Inspectors to travel with the trains?—Yes; I do not think that that was continued beyond February.

3717. Was the district of Karachi much infected?—No.

3718. The plague proceeded by the railway to Hyderabad?—Yes, the towns of Kotri and Thatta in the Karachi District were infected.

3719. They were only slightly infected?—Yes.

3720. The disease proceeded to Hyderabad, and eventually to Sukkur?—Yes.

3721. Sukkur is in the extreme north of the Province?—Yes.

3722. One branch of the railway goes to the Punjab and the other to the Quetta?—Yes. It branches off at Ruk, about 20 miles south of Sukkur.

3723. When did the epidemic begin in Sukkur?—The first case in Sukkur was on the 12th February.

3724. When did you go there?—I went on the 28th March.

3725. Did you carry out in Sukkur the same measures as had been carried out at Karachi?—Yes, but more thoroughly.

3726. You succeeded in evacuating the houses more completely?—Yes.

3727. How long did you keep the people away from their houses?—The people in the quarter I was concerned with in Sukkur were kept away for a month.

3728. And were the houses disinfected in the meantime?—Yes.

3729. Was there any recrudescence when the people went back?—No.

3730. During the period they were away from their houses were they strictly under your control in the observation camp?—Yes.

3731. There was no system by which they could get back to the city?—In Sukkur they were not allowed to go back to the city except under passes for special reasons. They were practically kept away altogether.

3732. There was no casual going back to the city?—No.

3733. What number had you in the camp?—From this quarter we sent in 600 people; of course a great number had previously left the town.

3734. And that quarter is the worst part of the town?—Yes.

3735. The poorest and most congested and the one which suffered most from the plague?—Yes.

3736. How long did it take to stamp out the epidemic in Sukkur?—It went up steadily, until it reached its highest, I think, in the second week in April, and then it went down very rapidly; the last case occurred on June 2nd.

3737. When did you evacuate this quarter of the town at Sukkur?—I think on 15th April.

3738. The plague did not extend either to Baluchistan or the Punjab from Sukkur?—No.

3739. There was a system of railway inspection on both the lines?—Yes, and detention, I think. I cannot speak about the Punjab, but they had in Baluchistan.

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3740. Subsequent to your employment at Sukkur you were employed on plague measures at Kotri?—I went back to Karachi.

3741. Have you anything particular to say as to what took place when you returned?—I was in another quarter, which had never been badly affected. It is a long way away from the worst part of the town, and we did not evacuate, we only segregated very freely. We segregated streets or componnds at a time, but beyond that we did not evacuate.

3742. You took out the people with plague and all contacts as far as possible?—Yes.

3743. Do you think you got all the contacts?—Yes.

3744. Because you had a system of taking everybody within a limited area?—Yes.

3745. The disease was then declining of itself, I think?—It was at its worst in the Sadr Bazar then, at the end of May.

3746. What is the size of the Sadr Bazar?—It has seven or eight thousand inhabitants.

3747. What amount of plague had they there?—One hundred and twenty-three cases altogether; I think the most was 20 in a week.

3748. It was never very virulent?—No.

3749. Then you went to Kotri; when did plague begin there?—On 29th October 1897.

3750. Did you take the whole population out of the town?—Yes.

3751. How many people are there?—The population of Kotri is 7,900.

3752. Did you provide camps for the whole of them?—The population is supposed to have decreased since the census and a good many people lived in hamlets which are not exactly in the town, and also in the railway quarters which are outside the town. So that I do not think we had to deal with more than 5,000 or 6,000 people.

3753. When did you take them out of the town?—We did not begin evacuation at first, but we tried to stop the plague by segregation.

3754. Taking the people affected and their neighbours?—Yes. I do not think we evacuated, that is to say, I do not think we had all the people out until the end of November, the 26th or 27th.

3755. Did you find this partial evacuation ineffective?—It brought the number of cases down very much, but did not entirely stop the disease.

3756. Afterwards you determined to take the whole population out?—Yes.

3757. And to disinfect the whole of their houses when they were out?—Yes.

3758. How long did you keep these 5,000 or 6,000 people in camp?—We did not let them back till the beginning of February. Those in hamlets were in their own sheds.

3759. Two-and-a-half months?—Yes.

3760. Were they allowed to do their business during that time?—Yes. We did allow them to go back to the town.

3761. Without any supervision?—We had the keys of all the dwelling houses, but they were allowed to go back to do their work. They did go back to their houses occasionally surreptitiously and we also allowed them to go back when they had any reason for doing so.

3762. What was the size of the cordon employed?—I believe about 140 men.

3763. All police?—Twenty-five sepoys of the Baluch Regiment and the rest police.

3764. How long were the men on duty at a time?—I think the police had watches of three hours and the military sepoys two hours.

3765. Have you any idea how many men were on duty at the same time?—I am sorry I have not the map with me. The posts are marked on it at intervals of 60 yards, I think.

3766. Is a cordon of that strength sufficient to prevent the inmates of the camp from leaving it in the dark?—Of course we had a guard on the camp too. I think it was sufficient since the registers of persons in the camps were kept up.

3767. They might go out and come back again?—Yes, and they did in one or two cases, but they were very rare.

3768. You do not think that that practice was prevalent?—No.

3769. You think that the cordon was effective in keeping them in?—Yes, because they would not venture to try to take their families through the cordon; the men might go out individually, but their families could not.

3770. When did Karachi become infected for the second time?—At the end of March 1898.

3771. This was a more violent epidemic than the other?—It was more violent at the time, but the total mortality was far less; far more vigorous measures were taken than in the first epidemic.

3772. Did you evacuate the whole town or only the infected houses?—Three quarters, called the Old Town, the Market, and the Machi Miani quarters.

3773. What is the approximate population?—I should say about 40,000, speaking from memory.

3774. Did you get them all in the camp?—We began to segregate, and we had our large camps, and they could not go away by rail, at least until after detention; and they made camps of their own. Then an order for the compulsory evacuation of the whole town was made, and the whole of the remaining people went out and formed their own camps.

3775. You think that the railway detention camp was good, and that it kept the people in the town?—It kept them from leaving the neighbourhood of Karachi. I think in the situation of Karachi it was undoubtedly a good thing.

3776. Do you think that the fact that the authorities detained there a number of people who subsequently developed plague, shows that it prevented the infection from spreading?—I believe so.

3777. There was no infection above Karachi, was there?—No, I think there were one or two cases which occurred after the ten days. I think there were two people who had been detained for ten days and who developed plague two or three days afterwards.

3778. They might have been re-infected by contact in the segregation camp?—They might have been, but it is the opinion of the officer in charge that they were not. There was an urgent business pass system—people with passes were allowed to go from Karachi.

3779. Whatever their appearance might be?—No; they would have to be respectable people and their business had to be important. One such passholder developed the plague at Cutch Mandvi, and one at Hyderabad.

3780. But they were liable to attack as much as any one else?—Yes. But there was a small number and we could warn people of their arrival, and we knew the houses from which they came.

3781. Did you do that?—Yes, those going to Hyderabad were not allowed into the town at all except under guard, and they were not allowed out at night.

3782. Have you anything to say with regard to the prevalence of rats during any of these epidemics?—In Karachi, in both the outbreaks, and in Sukkur many rats were noticed, but hardly any in Kotri.

3783. In the first outbreak in Karachi, and in the outbreak in Sukkur had you any evidence to show that the mortality among rats preceded the mortality among human beings?—No, I cannot say so except in individual cases, but not as a general rule.

3784. Is it your opinion that it did?—In the second epidemic in Karachi I think they did.

3785. Where did you find dead rats in such a large number in the second outbreak?—In the second outbreak we usually found them in gunnybags, but as a general rule we found them mostly in grain shops and flour mills.

3786. What distance are they in Karachi from the place where the ships unload?—About three or four miles.

3787. Did you find dead rats in the docks?—I do not know; not in large numbers anyhow.

3788. They were found in large numbers in the bazar?—In Karachi in the second epidemic it was localised at the commencement in one place, the place called the Joria Bazar.

3789. Rats were found there in large numbers?—Yes.

3790. How long before you detected the cases of plague were dead rats found there?—When we heard of the first four cases of plague, we went down the next morning and saw dead rats lying in the road which had been thrown out of the neighbouring houses. That is the first I saw of dead rats. They were immediately afterwards found in large numbers, and we were told that respectable native families

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had heard of those dead rats and had gone up-country at once. We were not told the names of those people.

3791. So far as you know, no rats were actually discovered before the cases of plague?—No.

3792. Although you think dead rats had been found which died before the cases were discovered?—Yes, we found rats which must have died before.

3793. In Sukkur in the first outbreak there were a great many rats in certain parts of the town?—Yes.

3794. Have you any facts which go to show that rats died there before the people?—No, I cannot say.

3795. Have you any idea of the origin of the outbreak in Kotri the second time?—No, we could not ascertain it at all.

3796. It was slightly infected at the first outbreak?—Yes. The first outbreak ended in the middle of May.

3797. There was an interval of five months between the outbreaks?—Yes, and no traceable source of infection from outside.

3798. Was the mortality high?—Very high in October and the end of September.

3799. Was it higher in the hot weather months of June and July?—No.

3800. Nor after the rains began?—No. It was the general opinion of the officers that it was a recrudescence, but that is only the belief of those working during the epidemic.

3801. Is there anything else you wish to say?—No, I do not think so, except with regard to the corpse inspection.

3802. You found no objection to corpse inspection at Karachi?—No. No great objection.

3803. The Muhammadans did not mind their bodies being examined by medical men?—They got accustomed to it in the first outbreak, and that was continued until the second outbreak. Just before the second outbreak they began to object and asked for a lady doctor. They had to pay fees for the services of the lady doctors.

3804. The only stipulation was that the bodies of women should be examined by lady doctors?—Till they asked for a lady doctor, the bodies of women were seen by the ordinary doctors.

3805. Were you surprised when they took to it so readily?—I do not think they regard the dead with anything like the same degree of respect that they do the living.

3806. It is your experience in Sind that the people had any objection whatever on this ground to corpse inspection?—I do not think they liked it anywhere.

3807. But they did not mind a body being touched after it was laid out?—No, it can always be examined through the clothes; there is no need to bare the body in any way.

3808. Can you detect the pulmonary form of plague by the appearance of the body?—No.

3809. In Sind you did not actually examine the bodies of women, did you?—No, not at the beginning of the first outbreak.

3810. When corpse inspection was going on in the first outbreak at Karachi, were the bodies of women examined?—I can say that I have known the bodies of many women examined but I cannot say whether they all were; I should think probably not.

3811. If you do not examine the bodies of women, is it of any use to examine those of men?—Quite useless.

3812. (*Dr. Ruffer.*)—You say that disinfection of the house did not prevent plague raging fifteen months afterwards; have you any facts to show that the plague may remain in a house for fifteen months?—They were re-infected. What I mean to say is that though they had been cleaned, and to a certain extent ventilated, that did not prevent plague going there again.

3813. I think you stated that 600 people were turned out of Sukkur?—Yes, from this one quarter.

3814. You say the height of the epidemic was in the second week in April?—Yes.

3815. They were evacuated on the 15th April?—Yes.

3816. How long was that before you noticed any difference in the mortality?—We evacuated this quarter because we were having five or six cases a day, and by segregation, which was pretty complete, we did not stop it. They were taken out on this day, and the day they were taken out we had one case; and they did not have another case after that.

3817. There ought to have been a certain number of people incubating plague?—Yes, we did not have them.

3818. What became of them? The incubation period is generally supposed to be ten days?—We could not explain that; that is why I mention the fact.

3819. Can you give me an explanation of it?—No, unless it is possible that being removed to better quarters and having more light and air the incubation was checked.

3820. You say the local officers believed the plague in Kotri to have been a spontaneous recrudescence?—We could trace no fresh infection from outside. Plague had been in Kotri before, and we could not trace any infection from outside.

3821. Do you think there might have been undetected cases of plague for some time?—So far as we know, there had not been, because there had been corpse inspection the whole time from the commencement of the first epidemic. We suppose it must have been continued some time in the town, but we do not know how.

3822. You said that two cases contracted plague ten days after coming into the camp?—Yes.

3823. Then these cases must have got infected in the camp?—Unless the period of incubation is longer than ten days.

3824. I do not think it is supposed to be longer than that; we have had no facts to show us that it was longer; so that these people must have contracted the disease in the camp probably?—If that is so, yes.

3825. Then the infection must have been present in the camp?—Yes.

3826. When these people left the camp, a certain amount of infection may have been carried?—There is always that possibility, but in no case did we have the plague spread in the camp itself by contact between person and person. As I said, I think that the medical officer in charge of the camp believed it to be a case of long incubation.

3827. How long after ten days?—I believe in one case, two days, and the other, three or four.

3828. (*Mr. Cumine.*)—Do you remember on what day the last case occurred in Kotri?—The last three or four days of January, about the 28th or 29th.

3829. And what was the date of the first case of the second outbreak in Karachi?—March 25th.

3830. To go back to Kotri. During the five months in which there was no plague in Kotri between the two outbreaks, was plague going on in any other places in Sind?—Not after the 27th of July in Karachi.

3831. When the second outbreak began in Karachi, a number of dead rats were, I believe, found amongst gunny-bags?—Yes.

3832. Is it not natural for rats and gunny-bags to be found together in the godowns of grain merchants; where you find gunny-bags, you would naturally find rats, would you not?—Yes. But that is no reason why you should find dead rats in one particular locality only.

3833. Did the gunny-bags come all from one place or at any rate the majority from one place?—I believe so.

3834. What place was that?—I believe from Bombay.

3835. Were these dead rats in a perfectly flattened out and dry condition?—They were in all conditions, dry rats and freshly dead rats.

3836. If rats and gunny-bags are habitually found together, then, even though the rats had got infected from some source other than the gunny bags, you would find the dead rats among the gunny-bags, would not you?—Yes.

3837. (*Prof. Wright.*)—As to the effect of using compulsion in the first outbreak at Karachi, I was not able to understand what difference you think the application of compulsion made in spreading the epidemic. You say in your précis that compulsory measures made the plague spread "*less steadily*"; does that mean that after the application of compulsion plague was no longer confined to one quarter of the town?—It spread right through the quarter and then went on to another quarter.

3838. And when you used compulsion, you drove people out and scattered them all over the town?—No, we took measures to try to prevent them going to other parts of the town.

3839. You say when you used compulsion the plague spread "*more quickly*", that is, the mortality went up, but the spread was less steady. Does that mean that the plague cases were distributed in different quarters of the town instead of being in one?—No, they were mostly driven out into the open. It was not the compulsory measures which made the numbers go up.

3840. I thought you meant that you scattered your people all over the town and you got greater mortality?—No, I said they did not appreciably move from one quarter to another.

3841. You say in your précis of evidence—"The disease spread possibly more slowly than in cases in which compulsion has been used from the outset." Does that mean that the mortality went up more slowly when you did not use compulsion?—If you look a little lower down, you will see I say—"The rats died in far greater numbers than in the first outbreak, and the spread of the disease was far more rapid. This could not be ascribed to the fear of our measures, for the people did not appreciably move from one quarter to another."

3842. If you leave a plague epidemic in a town to itself, what course do you think it would take? Would it keep in one quarter and kill more individuals in the families which are attacked?—Yes, and then spread to other quarters.

3843. But are not these the most suitable conditions for application of disinfecting measures where plague is confined to a small locality and where the cases occur in a small number of houses?—Yes.

3844. Is it not an easy thing to deal with places by disinfection when you have those conditions?—I do not think it is easy because disinfection alone does not stop the disease, because you have not got the infected people and you do not know in what way the disease spreads over the other parts of the town.

3845. When you apply force, the people are scattered?—No, I said in my précis, in the second outbreak "this could not be ascribed to the fear of our measures, for the people did not appreciably move from one quarter to another."

3846. In the first paragraph you say the epidemic was left to itself first, and compulsion applied afterwards?—Yes.

3847. And you observed a certain effect on the mortality from the application of that compulsion?—No, I am sorry my words convey that meaning; for instance, in Karachi, immediately compulsion began to be used, the numbers did not go up.

3848. I only say you applied compulsion and observed a particular effect. I am ready to learn from you what that effect was. Had you diminution of mortality when you applied compulsion; I understand this précis to convey that you had a greater mortality when you applied compulsion?—No, I did not mean that. In the first epidemic at Karachi we did not have compulsion, and in the second epidemic we did. I did not mean to convey the impression that compulsion made the disease spread more quickly because in my rough précis of the second outbreak I said it did not in Karachi.

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3849. Let us confine ourselves to this first outbreak. During the first part was compulsion much applied?—The more perfect compulsion was, the more steadily the number went down; but I do not believe that compulsion was used till the disease had reached its climax.

3850. The result of that compulsion then was to diminish the mortality?—Yes, a much more rapid diminution, I think.

3851. But a further effect of compulsion was to bring about a distribution of the plague cases in the town?—No, I do not think so.

3852. Do you then believe that the application of compulsion had no effect on the spread of plague through the different quarters of the town?—I do not think compulsion spread the disease through Karachi more quickly.

3853. I simply want to know what you mean by the statement in your précis?—In Karachi I believe the more rapid spread in the second outbreak was due to rats.

3854. I want to know what effect was seen when you applied compulsion?—I do not think it spread the disease any more quickly in the town.

3855. But were the deaths from plague all confined to the same quarter of the town, or were they pepper-castored all over the town?—They were pepper-castored all over the town, but I could not say that that was the result of compulsion.

3856. The statement in your précis says that you applied a particular measure and observed a particular effect; you do not seem clear as to whether the mortality went up or down?—It went down.

3857. The word "slowly" as used by you in your précis is then very misleading?—I will withdraw that word if it causes a misunderstanding. The cases were pepper-castored all over the town because the original quarters were empty by the time compulsion was applied.

3858. There is the third alternative, that your measures did not influence either the mortality or the spread of plague?—I say the effect was to diminish the mortality. But I do not believe it spreads the disease: the disease remained in the same quarters afterwards as before. When compulsion was used, the first epidemic had been already spread.

3859. (*Mr. Hewett.*)—Is your meaning that evacuation caused the mortality to go down rapidly?—Yes.

3860. And that it did not in your opinion spread the disease to places where it would not have gone otherwise?—That is so.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Mayo Hall, Bangalore.

THIRTEENTH DAY.

Thursday, December 15th, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

LIEUTENANT-COLONEL W. G. KING, I.M.S., called and examined.

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3861. (*The President.*)—I believe you are a Bachelor of Medicine and Master of Surgery and hold Diploma in Public Health?—Yes, from the Aberdeen University.

3862. You are Sanitary Commissioner for Madras?—Yes.

3863. You have the superintendence of the plague measures in Madras?—I have solely to advise the Government on the subject. At the present moment there is a Plague Commissioner who superintends and directs measures.

3864. You are prepared to give us some information with regard to a system of "observation"?—Yes.

3865. Will you kindly proceed to do so?—As regards rural areas, we have so-called circles of 10 miles diameter. These

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stretch right along our borders in a double row: therefore, we have 20 miles of our borders now under observation. Each circle is in charge of a Sanitary Inspector. He is a mounted man. In charge of each four circles is a Plague Supervisor. Those districts which are selected by Government as imminently threatened have special staffs in addition to their ordinary sanitary staffs, called "observation staffs"; these observation staffs will be strengthened when the epidemic actually appears. Lately, as regards observation circles in rural tracts, it has been ruled that where an infected area is found, these circles shall be contracted to half the diameter; that is, that round an actually indigenously infected village in a radius of 20 miles there would be a series of circles, each in charge of a Sanitary Inspector, having a radius of 2½ miles respectively. The object with which these observation circles are formed is to enable us to work a passport system under which persons from the frontier are examined. If healthy, they are at once given a passport on which is stated that it is their duty to present themselves to the Head of the village, or other local authorities named on the passport, for ten days. If at any time a person holding a passport is found to have suspicious symptoms of plague, he can be isolated by any of these authorities. In addition to the circles, we have what are called frontier road stations on all our main roads, where also either a Sanitary Inspector or a Hospital Assistant is stationed, with arrangements for camps sufficient for the detention of suspicious persons, and such persons as are not able to give trustworthy addresses. Further, we have observation stations at our railways. The larger ones are provided with camps, and with Commissioned Medical Officers. Minor stations are entrusted to Municipal Staffs, if they happen to be serving the Municipality, and in the case of smaller stations, either the Station Master or the Police are responsible for checking persons with passports. At frontier railway stations and all stations serving infected areas tickets are specially marked so that it is possible to check the passport system by them. Our sea-ports are worked on the system which has been recognised by the Venice Convention; the Regulation on this subject is practically word for word that adopted by the Local Government Board of England. The whole system, therefore, is that of "observation", as against detention in camps of the sick and healthy alike under conditions of quarantine.

3866. You are satisfied with the system that you have described?—I think it has worked very well indeed: it is not infallible.

3867. Could you illustrate any of the advantages?—If we had adopted the opposite system of having land quarantine camps, undoubtedly we should not have had anything like the proportion of persons under observation as we have by this system. Even with the observation camps we have now at the railway stations, people knowing that they can pass through simply with a passport, do at the present time, attempt their best to avoid these stations; and therefore it is a perfectly fair argument that if they would try to avoid those stations where every facility is given them to pass through, much more would this be the case if we attempted to detain them entirely. I did not know I was to be a witness until within a few days back, and statistics have not been prepared on the subject. Before I left Madras, I telegraphed to three districts. The Collector of one district, in answer to my request to supply me with statistics as to the number of persons evading the passport system, which would be the real test and one which I presume, you would require, told me he could not do so in the time. As regards Madras City, I find that the total number who have evaded the passport system out of 5,500, gives us only 2 per cent. of evasion. In the North Arcot district, where our "observation" circles have been but recently opened, I suspect that they have included the number who came with pass ports before these observation circles were opened. Therefore they are somewhat at a disadvantage. There, the number of evasions is heavy comparatively, that is to say, 15 per cent. In the district of Salem the Collector reports that the number of evasions is only 2 per cent. I believe that in the case of Bellary they were not capable of supplying statistics, but I think it will be found that the system works even better there, or at any rate, quite as well as in the case of Salem, as I know the Collector is very strict in the matter. All evasions have been prosecuted, and an infinite trouble taken to trace persons who have attempted evasion. Granting that what I have been able to tell you is not full, I think it points to the fact that it is possible to use an observation system, and thus contribute to the absence of interruption of trade, and the irritation which camps of detention have absolutely afforded. I think myself that the great aim in all these measures is to interfere as little as possible with the healthy, because by interfering with the healthy so many private interests are obstructed that discontent is liable to arise. It is on that principle that the Madras Government has attempted to work the system.

3868. In order to prevent the entrance of plague into the Presidency?—Yes.

3869. How far has it been successful?—I have given statistics which, I think, would be the best test.

3870. Have you got them here?—I will get them from the office and supply them. [Note added by witness on correcting proof of his statement:—I now find that the percentage of evasions was as follows:—

Madras Town	. .	2·0 per cent.
Bellary District	. .	12·6 „
North Arcot	. . .	10·5 „
Salem	. . . .	1·0 „

The number of passports concerned in Bellary was 8,580, and the majority of those untraced are reported to relate to people who have gone on to other places before the expiry of 10 days. In North Arcot the figures are based on 7,671 passports concerning 11,092 persons. The large percentage of evasions is partly due to the fact that large numbers of persons from just over the Mysore border attend markets just within the Bellary district, and as they only stay a few hours in the district they are not traced.]

3871. You have also had an opportunity of observing the preventive effects of inoculation?—I cannot say I have seen much of it, because in Madras we have been more recently attacked with plague than anywhere else. Our attacks date from a very recent period. From the very commencement, from the time that M. Haffkine started inoculation, our Government took particular interest in the matter and deputed Major Bannerman to go to Bombay on purpose to study the question. He was there for a period of nine months, and he is now at the present time practically on special duty with reference to inoculation, and he is doing his best to propagate belief in its usefulness. We are attempting to spread it in all directions. We have given special instructions to the District Medical Officers, and the question is now under the consideration of the Government of allowing even Civil Apothecaries to undertake the measure; so that the outturn of operations will be enormously increased.

3872. Judging from the facts that have come under your observation, do you think the measure has been a useful one? Assuming that Haffkine's fluid is distinctly prophylactic, would it be possible to inoculate so extensively as to protect Madras against an invasion of plague?—That fact, I think, has been ascertained. Major Bannerman, who is an expert in this matter, has been giving frequent popular lectures on the subject in Madras, and the result of those lectures has been that during the last two and a half months about 5,600 have been inoculated out of a population of 450,000. Major Bannerman has been assisted by three Medical Officers specially deputed for this duty: there are four District Surgeons, who also give their aid; and that would make altogether 8 officers besides one female doctor attempting to propagate inoculation. It has been well received by our educated classes; but the practical difficulty seems to me to be to get an operation of that sort accepted—especially by certain classes of the people and the uneducated generally—in time to secure a prevention of the spread of the disease: that is to say, I do not think it is possible—it is not within the practical sphere of sanitation—to say that any area can be so prepared beforehand as to prevent an invasion of plague. People will not accept it in time. Experience shows that after plague has entered into a place,—I am speaking of it now partly from my own observation and specially from what I have heard of results elsewhere,—the people begin to realise the utility of it. Although they undertake it still they do not do it to such an extent, or at such a rate, that it could be trusted to solely. In my opinion, inoculation can only be used as an aid, and I think a very valuable aid, to sanitation. I have attempted my best to struggle against the opinion of those who contend that we should throw up all sanitary measures and simply take to the inoculation syringe.

3873. What do you mean by sanitation as a preventive measure?—Preparing the area.

3874. What do you mean by "preparing"?—Securing as high a sanitary condition as possible.

3875. Will you condescend to some details: what do you exactly mean?—With reference to water-supply, drainage, conservancy: all these matters I think are fairly those

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which would come under preparing an area for any epidemic, irrespective of the one we are talking about.

3876. Over-crowding?—Yes, certainly.

3877. Have you had much plague in Madras City itself?—No; only imported cases up to date.

3878. How many?—According to the last returns I got, I think there were seven.

3879. Can you give me the date of the first and the last?—I am afraid I cannot. The Health Officer will be able to give that information.

3880. Have you had anything to do with the measures which have been adopted to deal with cases which have been introduced into Madras?—I have been consulted by the Government with reference to the precautionary measures that have been taken in the City of Madras.

3881. Would you have the direction of the operations?—That would come under the Health Officer, subject to the control of the President of the Municipal Commission of the City. I may say that before the introduction of these cases into the City of Madras, as early as 1897, cases were introduced, but they were promptly seized under the "observation" system and no spread occurred.

3882. (*Mr. Hewett.*)—Have you stated the districts of the Madras Presidency in which you have had plague?—They are North Arcot, Salem, Bellary and Anantapur.

3883. How did infection get to North Arcot?—It was imported from Bangalore.

3884. Is that the district to which those persons went from an infected house in Bangalore City?—Numerous cases have been imported from the Bangalore City and the Mysore Territory generally.

3885. Did not remnants of families go from Bangalore City into the North Arcot District?—Numbers of cases of that sort have occurred. In this map* I show you localities in which imported cases have been detected under the passport system.

3886. Can you give the date of the first imported case in the North Arcot District?—No. I should say it would be about September.

3887. Was it not reported that these people had gone from Bangalore City to North Arcot?—You were speaking of the case at Tiruvallum.

3888. Was any focus of infection established in this place?—No; indigenous plague did not occur as the result.

3889. When did the first indigenous case take place in the North Arcot District?—It is not indigenously infected up to date.

3890. What district is indigenously infected?—Anantapur.

3891. At what place?—Near Guntakal. That is the only place in the Anantapur district we have now. Since I have been here it has been reported to me that Hosur, which is about 25 miles from here, is indigenously infected.

3892. The infection in Guntakal is on the line of railway from here?—Yes.

3893. And Hosur?—It is on the direct road from here: there is no railway.

3894. What is the system of death registration in the rural areas of the Madras Presidency?—All deaths and births are ascertained by the Karnam, the village accountant.

3895. He enters them in a Register?—Yes, he enters them in a Register.

3896. Is he responsible for entering the cause of death in the Register?—Yes.

3897. What does he do with the Register? Does he keep it by him or send extracts to the Civil and Medical Officers of the district?—First of all it is abstracted in the office of the Tahsildar. From thence it goes to the Collector's Office, where the whole District Returns are compiled. They then pass through the District Medical Officer who sends them to me.

3898. Supposing that there has been an abnormal mortality in any village in a district, who is responsible for calling attention to it?—Primarily, the Head of the village.

3899. Does he report to the District Officer or to the Inspector?—The Tahsildar would be responsible for bringing it to the notice of the District Officer.

3900. The responsibility rests with the Collector through his subordinates?—Yes.

3901. Has the general death rate in the Madras Presidency been high or low this year?—It has not been above the average.

3902. In Madras City it has been very heavy?—Abnormally high.

3903. Excluding cholera?—Excluding cholera.

3904. Can you account for that in any way?—Yes; I think it is chiefly because there has been more cholera than has been reported. I investigated the matter with the Health Officer. I went round the town and went into the subject with the idea that it might be plague. We went carefully into the matter, and we found reason to believe cases of cholera had been concealed. I think the mortality is chiefly due to these cases which have been entered under fever."

3905. You have no reason to suspect plague in Madras?—No. We hunted up every possible source of information.

3906. (*The President.*)—You say that a great many cases of cholera were concealed?—Yes.

3907. Why were they concealed?—I think there was an idea that the Municipal Sanitary staff were looking for cases of plague, and the inhabitants thought their houses would be disinfected.

3908. They were afraid of their houses being disinfected?—Yes.

3909. They themselves were very doubtful whether the cases were plague or cholera?—I have no doubt that they knew perfectly well it was cholera.

3910. (*Mr. Hewett.*)—In your précis of evidence you referred to a system of "camps of detention" practised elsewhere: have you seen any of those?—No.

3911. Where do you think they are practised?—There are camps at Bombay. Originally, I think they were in Bengal also.

3912. Where did you get your information with regard to that?—From the Sanitary Commissioner's report. At Khana every person arriving from infected localities is stopped there.

3913. Outside the Bombay Presidency, have you heard of "detention camps" as opposed to "camps of observation"?—I looked upon Khana in Bengal as one.

3914. But you have no knowledge that the system practised outside the Bombay Presidency has been other than the system for detaining persons which were suspicious: it is practically the same system as in Madras, is it not?—I understand not.

3915. But how did you understand that?—Under the passport system a person is allowed to go on. What I understood was that in areas other than Bombay, Local Governments had instituted solely on the line of rail "observation stations." Khana was officially described by the Sanitary Commissioner as a "quarantine encampment", and he issued rules for medical officers in charge of "quarantine plague camps" in Bengal. The system thus sanctioned by the Bengal Government permitted detention of "suspects" from infected areas, but made no arrangement for "observation" of the apparently healthy from infected areas during their passage through, or stay in, that Presidency for a period of ten days, as pursued in Madras. It could not rightly therefore be regarded as a system of "observation."

3916. There is a telegram from the Government of India to the Government of Madras, of February 1897,† prescribing, with the object of keeping a necessary watch on travellers by rail, that suspicious persons should be detained, and others from infected areas required to furnish their names and addresses and such an account of themselves as would enable their future movements to be stopped. That is practically the system in Madras?—It only applied to Railway Stations. I agree they had elsewhere a system of medical detection confined to the Railway Stations. We have extended our system of "observation" right through our rural areas. I understand that no such system exists in other parts of India.

3917. Has there been any system of detention camps by penning the people up on the roads?—I think I am correct as regards Bombay.

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* Not published in the Proceedings of the Commission.

† Telegram dated 19th February 1897 printed at page 127, Volume III of Nathan's "Plague in India, 1896-97."

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3918. Please leave Bombay out of the question: I know there have been detention camps in the Bombay Presidency?—They had a system of observation confined solely to the line of rail. Therefore there is a vast difference between the system in Madras which employs a complete net of circles of observation down to its borders, embracing towns and rural areas—not solely roads or railways.

3919. Is there not a difference between Madras and other places, because up to date the other places have not reached a stage where they require observation on roads?—We considered we required an observation system because we were in communication with those areas and reference to the reply * of the Government of Madras to the Government of India's telegram will show that this mode had been adopted in Madras before receipt of its general directions in the same spirit.

3920. (*Dr. Ruffer.*)—You told us that you had a system of Sanitary Inspectors and Plague Supervisors on the frontiers: are the Sanitary Inspectors and Plague Supervisors Medical men?—No, the Sanitary Inspectors and Plague Supervisors are simply trained in sanitation.

3921. How?—They undergo a three months' course at the Madras Medical College under the Professor of Hygiene. They also receive a course of practical sanitary demonstrations under me and my Deputy. They then pass an examination.

3922. What class of men do you choose for that purpose?—We require that they should undergo the Matriculation examination of the University of Madras; but I have the right of nominating persons of inferior educational qualifications. I have diminished that number from year to year, until now there are not more than 15 per cent. of such men. Many of our men are B. As. and F. As.

3923. They have had three months' training?—Yes.

3924. Are these men familiar with plague?—They have seen cases of plague now in all these places.

3925. In places where there has been plague;—but before that, had they any experience of plague?—They had no practical experience but they were trained by me as to symptoms presented by plague cases before being appointed to this special work.

3926. You say you have divided each district into circles: have you any provision for disinfection? Have these Sanitary disinfectors and Plague Supervisors any disinfecting apparatus or chemicals?—They are provided with chemicals.

3927. What chemicals do you supply?—Perchloride of mercury is one chemical: we chiefly rely upon this combined with hydrochloric acid. In disinfecting slimy mud of courtyards, a solution of sulphuric acid is preferred.

3928. Have they been trained in disinfection?—Yes. They have been trained in the disinfection of plague houses.

3929. With regard to the passport system,—you say the people present themselves every ten days to the Headman of the village. Does the Headman get any notification of the arrival of these people in his district from the Railway or other authorities?—Yes; he gets one part of the form given to him which says where a person is going to. It is sent on.

3930. So that the Headman of the village is warned of that person's arrival?—Yes.

3931. And most of the people report themselves?—We find they do.

3932. You said in your evidence that in Madras City you had only 2 per cent. of evasions; in various other places the number of evasions varied from 2 to 15 per cent; are these all the evasions you know of?—Yes.

3933. But there may be other evasions that you do not know of?—Yes; it is not infallible.

3934. So that the numbers you gave are simply approximate?—Of evasions, Oh no! That is to say, if a passport is issued, the figures I gave you are accurate. We have lists of those which have been evaded. What I mean to say is that it is possible for persons to get in without passports: but I do not think this is frequent.

3935. I take it that two per cent. is the very minimum figure of evasions which have taken place?—I should think so. It is a very satisfactory figure.

3936. I think you said there were three districts in which cases of plague had been imported. I did not gather from your evidence what you did with these cases of plague?—They were at once isolated: the contacts were also segregated. Our Regulations require that this should, in the first place, be effected by the Village Headman. By express he sends intelligence to the Sanitary Inspector of the Circle and to the Tahsildar. The latter informs the Collector and District Medical Officer by telegram, and, taking with him the nearest Medical officer, proceeds to the spot. The Sanitary Inspector, being within a radius of five miles, should be the first on the spot. He sees to disinfection and segregation, and the general sanitation of the village. The Collector (or Plague Officer) and the District Medical (or Additional Medical) Officer proceeds to the spot with an ambulance and disinfecting staff kept in readiness. On its arrival, the Sanitary Inspector of the Circle resumes his duty of observation, and the local Medical officer brought by the Tahsildar returns to his ordinary duty.

3937. How is the disinfection performed?—Usually with perchloride of mercury and hydrochloric acid solution: we prefer that.

3938. Do you disinfect the whole house?—Yes, throughout.

3939. Have you any statistics as to the mortality of the contacts afterwards?—No, we are not sufficiently advanced yet.

3940. Are you satisfied that you get most of the contacts of these cases?—I think up to date we have been very fairly successful.

3941. But you have no numbers?—We have never got into a condition where a huge city is involved. Attacks are still confined to rural areas. We have been able to seize case after case and separate the people. So far our reports have been very satisfactory.

3942. (*Mr. Cumine.*)—What is the frontier which you attempt to defend by this "observation" system, is it the whole of the Mysore Frontier?—Yes.

3943. The Nizam's Frontier and the frontier of the Mysore State?—Yes.

3944. Do you attempt to watch all the roads leading out of the Nizam's Dominions and the Mysore State?—There is a large river here. Wherever there are fordable places, we have stations.

3945. Do you attempt to watch all the roads along the Mysore frontier?—No, not all the roads. If a person escaped by a minor road, it is supposed that he would be at once involved in this net of observation circles. All the main roads are watched.

3946. Supposing he escaped by a minor road, and got into a village, who would report his arrival?—The Village Headman. He is bound to report an arrival of that description. He would go at once and question the person, and ask him where he came from. If he found that the man came from an infected area, and had not a passport, he would be made to sign a passport.

3947. As the plague has got into certain parts of the Madras Presidency, has a cordon of observation been drawn round those parts also, and are the roads leading from them also watched?—Take the case of Guntakal. There we have specially contracted the size of our circles, so as to enable inspection and observation to be more accurate. Thus in a radius of twenty miles round an infected area "preventive circles" of five miles diameter are formed, instead of "observation circles" of ten miles diameter. In other words, the number of circles is doubled.

3948. To what extent can you get European supervision for supervising the people that you have on observation duty on the roads?—Our Plague Supervisors are chiefly Europeans and Eurasians. I think there is only one Plague Supervisor now who is a native.

3949. In the first instance, I suppose you have to trust to native agency to decide whether travellers are to be allowed to pass or not?—Yes, native agency.

3950. Are passports granted to everybody who comes?—All persons passing from an infected area would be provided with passports.

3951. A person's address is given on the passport?—Where he is going to.

3952. If he is going to a big town, is it possible to get a definite address?—Very often it is difficult. But in Madras up to two per cent. have been detected in that way,—out of 5,500.

3953. How are the passports sent on to the place of destination?—By post.

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* Telegram dated 23rd February 1897, printed at page 129, Volume III of Nathan's "Plague in India, 1896-97."

3954. Have the villagers been warned as much as possible throughout the Presidency to keep strangers out?—No doubt in all the circles where Sanitary Inspectors are, they must be fully aware of the necessity for this precaution. The size of the circle is such that usually within seven days every village is inspected by a Sanitary Inspector. He is in constant communication with the Head of the village. That idea has been well put into the people,—that they should take care about these persons. The tendency is to report them. In fact in some places whenever they have found persons, they have put them outside the village for ten days: they have voluntarily exercised a severe system of quarantine. On the other hand, in some places, villagers connive at concealment.

3955. Is it the business of the native officials who undertake this observation to go and examine the death registers in as many villages as possible to see whether there have been any suspicious deaths?—Yes. Every fortnight the Tahsildar in these special circles is bound to find out the condition of his Register, otherwise our returns only come in every month. The registration is particularly looked after at the present time, especially in these areas.

3956. Do you think the native officials at the observation posts on the main roads can be trusted to be honest in the matter of stopping people, or in not exacting money from healthy people to let them pass: have you any complaints of blackmailing?—Not up to date. The tendency would be to believe that that would be possible, but we employ a very good class of men as Sanitary Inspectors,—well educated men who have matriculated at the University and have something to lose. We give a Sanitary Inspector Rs. 70—including travelling and horse allowances—a month, which is very good pay for a native of that class. Taking that fact into consideration, I do not think there is a tendency to blackmailing. If you were to employ a poorly educated and badly paid class of natives corrupt practices would no doubt prevail. We have also the safeguard of each four circles being under Plague Supervisors, whose sole duty is to keep themselves informed of the conduct of duty by the Sanitary Inspectors.

3957. Do you find they stop many people on suspicion,—people who appear to have fever,—who yet turn out not to have plague after all?—No, there is not very much of that. Detention differs in different districts. In the Bellary district they are strict and detain every man who has at all a dirty aspect.

3958. If a man is detained on suspicion who decides whether it is a plague case or not?—The case is reported to the Tahsildar, who proceeds to the spot taking with him the nearest Hospital Assistant. Hasty preparations are made on the spot, and information is at once sent to the District Medical Officer and Collector.

3959. Is every person who is detained reported?—Certainly, if he is reported as a suspicious case of plague.

3960. Suppose he has dirty baggage and is detained on that account, what happens?—There is a register kept at these frontier stations, which shows how long they were kept.

3961. Is there any order that they are not to be kept beyond a certain number of days?—Not beyond ten days.

3962. Are they allowed to go on with their baggage?—It is disinfected.

3963. Do you think the reduction of overcrowding in a town not yet affected with plague is practicable? You spoke of it, I think, as one of the ways of "preparing" an area for plague?—I understood the President to refer to sanitary measures in a general sense, and not "preparing" for plague as a practical measure. I should never think of it: as a matter of fact it could not be done. This valuable effort must proceed by degrees, as a current method in the general sanitary improvement of towns and villages.

3964. (*Mr Hewett.*)—Have you any Assistant Surgeons in the Sanitary Department?—No.

3965. None of your subordinates are either Assistant Surgeons or Hospital Assistants?—I have no Department as such, except the Vaccination Department.

3966. You have Inspectors of Vaccination in the Sanitary Department, have you not?—Yes.

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3967. Are any of these men Assistant Surgeons or Hospital Assistants?—We have some Hospital Assistants, but no Assistant Surgeons.

3968. What proportion of them are Hospital Assistants?—A very small number indeed, I could not tell.

3969. They have a certain amount of medical knowledge?—Yes.

3970. Is there a scheme for getting Assistant Surgeons into the Sanitary Department?—We consider our Assistant Surgeons attached to the districts sufficient.

3971. They are under the Civil Surgeon?—Yes; and therefore through me form part of the Sanitary Department.

3972. Their primary duty is to attend to the dispensaries?—Yes. The object of their appointment is to allow District Medical Officers to go out on tour.

3973. Would it be an improvement if you could increase the number of Hospital Assistants so employed?—I do not think it would be an improvement. I have, perhaps, extraordinary ideas on this subject. For ordinary sanitary work, I do not myself think it is necessary that a man should have medical training. For executive sanitary work, I should be just as content to have a man with engineering training as a man with medical training. I look upon either simply as a foundation for sanitary knowledge.

3974. Assuming that a Hospital Assistant was given the same training in sanitary knowledge, would he not be more useful because he had medical training?—You have to consider what class of general education he had as a Hospital Assistant. As a matter of fact, the Hospital Assistant is a failure with reference to general education. Matriculates have a better education, and are far more useful. They are capable of making the reports, and of understanding the work better. In our examinations of these Sanitary Inspectors, we find Hospital Assistants come down very low indeed. We find the other men are more capable of absorbing knowledge.—I prefer Matriculates.

3975. You do not think that there would be advantage in having men with a medical knowledge such as Assistant Surgeons in your Department?—Yes, if you could confine the employment of medical men to that or a superior class.

3976. I suppose the number of Assistant Surgeons is limited?—If the money were supplied, we could get any number of them: because, in Madras, it is notorious that competition for employment by well educated men is very keen.

3977. You think the Sanitary Department might be improved in time in that way?—Yes. My previous remarks referred solely to executive Sanitary Inspectors. If you come to the Assistant Surgeon class, it is much superior.

3978. The Assistant Surgeon would have the advantage of having medical knowledge?—Yes; as well as the essential of a good general education, which the Hospital Assistant class has not.

3979. (*Dr. Ruffer.*)—Who makes the diagnosis of plague in the first instance,—the Sanitary Inspector?—He makes no diagnosis. He is particularly warned against that. He reports it as a suspicious case of plague, until a medical man comes.

3980. How long does it take, on an average, before the medical man gets on the spot?—Our hospitals are generally ten miles apart from each other.

3981. Then it takes several hours, and sometimes it might take a day?—Yes. It would take a few hours.

3982. Would it not be better if the Sanitary Inspector were competent to make the diagnosis?—It would be an advantage, but we are talking as to what is possible in this case. I have already yielded that fact if we had a superior class of medical men placed at disposal. If we had Assistant Surgeons, I would require them to undergo a special course of instruction before working them with the Sanitary Inspector class; but having regard to the general education of the Hospital Assistant, I prefer not to have them.

3983. You admit it would be better if the Sanitary Inspector had a medical education?—Yes, provided that the education was of a better class than that of Hospital Assistants.

(Witness withdrew.)

MAJOR W. B. BANNERMAN, I.M.S., called and examined.

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3984. (*The President*.)—You are a Member of the Indian Medical Service, and Deputy Sanitary Commissioner for Madras?—Yes.

3985. What are your qualifications?—M.D., Edinburgh, and B. Sc. in Public Health of the same University.

3986. (*Prof. Wright*).—I think you have had considerable practical experience of M. Haffkine's system of inoculation?—Yes.

3987. Have you always found the vaccine in a satisfactory condition?—The number of bottles I have had to reject is very few indeed.

3988. Do you examine each bottle to see whether it ought to be rejected?—Yes.

3989. How do you examine it?—By its appearance, and also by smelling it.

3990. What proportion of bottles do you think you have to reject: is it one per cent.?—Not nearly so much as that; I am quite sure it is less than that.

3991. When a bottle is rejected, is it because there are flaws in the sealing wax, or the way it is done up?—You may sometimes find moulds growing on the material in the bottle, or the bottle may be cracked, or the material may have a bad smell, in which case of course you would reject it at once.

3992. Is there always a palpable flaw in the sealing wax or in the bottle when you find moulds growing in it, or when you find a bad smell?—I think there is always a palpable flaw. On some occasions I have traced mould growing down between the cork and the neck of the bottle. Mould has also been found inside growing from a small crack in the sealing wax.

3993. You think that the contaminations have always occurred after the prophylactic has been sent out,—in transit?—Yes.

3994. What method do you employ for standardising the vaccine: do you in every case employ the doses which are prescribed on the bottle?—Yes.

3995. You do not adopt the method of testing the vaccine first on a series of 20 patients and adjusting your dose according to the degree of fever which is produced?—No. That is done in the laboratory before the material is sent out, or at least used to be, when I was working there.

3996. Do you find you get sufficient reaction in all cases by using the doses on the bottle?—As a rule. I find some people do not react, however: I mean to say that supposing six people are done out of one bottle, perhaps one person out of six may have almost no fever at all, whilst the other five may have a proper amount of fever.

3997. Have you known an instance where you have given six patients doses out of one bottle and none of them have reacted sufficiently?—We do them in such large numbers that we hardly ever see the people again. Generally, we hear of these people who have had no fever by their coming back themselves and enquiring why they have not had fever and whether they are properly protected in consequence.

3998. Has it often come to your attention that a number of people after one set of inoculations from a particular brew have come back in large numbers to complain that they have not had enough fever?—I have never had such an experience. The brews, by the time they reach the inoculator, are all mixed up. We do not have a series of bottles of one brew. The bottles, as a rule, bear different numbers.

3999. You have to give a different dose of each particular brew?—Yes.

4000. Does not that give trouble in practice in adjusting the dose to each bottle?—One has to get used to that. I calculate the doses according to the standard, and multiply by the figure written on the bottle.

4001. I do not follow that?—There are labels on the bottle. I calculate the dose for a person according to the standard and multiply by two or three or four times,—according as it is written on the bottle.

4002. The standard test is 2½ c. c.; and you multiply that by three or four?—Yes.

4003. It would save multiplication if the dose was written 'en clair' in c.c. on the bottles?—Admitting that it is written on in c. c.; this merely indicates the dose for an adult; for a weakly person, or a child you have to calculate.

4004. Do you find that children stand proportionately a larger dose?—Yes, they do.

4005. Do you vaccinate twice, or do you content yourself with a single vaccination?—In Madras we have only been vaccinating once. Several people have come up asking to be done twice, but up to date we have only done it once as a rule. I have told them that if plague comes near them they ought to come back and have a second dose.

4006. Is it your opinion that a second vaccination is advisable?—I do not think I can pass an opinion upon that. M. Haffkine, I think, recommends a second dose, but I could not pass an opinion upon that.

4007. Do you make the second inoculation on the same part of the body as you make the first, or on a different part?—On the same part, that is to say, of course, when the inflammation has disappeared. If a man comes within three days (as they sometimes do) for a second inoculation I do it on the other arm, because the inflammation of the first arm would not have gone down.

4008. What is the shortest period in which, after having once inoculated, you would re-inoculate?—I think three days.

4009. Do you find that the results of the second vaccination are more severe than the results of the first when you inoculate within such a short period as three days?—I do not think there is any rule. The result of the second inoculation is sometimes more, and sometimes less. In my own case it was much less the second time. I have, however, known people have a much worse reaction on the second occasion than on the first.

4010. Does that bear any relation to the date at which you re-inoculate?—I do not know.

4011. Have you seen any evil symptoms resulting from inoculation—abscesses?—No. I only know of one case having occurred: that was not done by myself. It is only hearsay. I did not see it.

4012. Have you seen any reactions which you thought too severe reactions—I mean by which life was endangered?—No. I saw a man the other day in Madras who had a temperature of 105° for two days, but his life was in no danger during the time. He recovered eventually and got quite well.

4013. Do you find that a considerable number of people suffer acute plague 24 hours after the first inoculation?—I do not know, I have no personal experience of that. Judging from the Undhera experiments, I should say such was not the case, because of the two people there who took plague without an interval between the inoculation fever and the plague fever, one of them lived 11 days, and the other recovered.

4014. Do you find that any considerable portion of the population are willing to submit themselves to these inoculations?—Even when plague is present, at first they are naturally not willing, but if you explain the matter to them fully, you generally get three or four the first day who are willing to submit themselves. The people watch these, and as they see them recover, and nothing happens, they come forward. The news spreads rapidly after two or three days.

4015. From the point of view of practical plague policy, if plague broke out in a town or village would you not have to contemplate a stay of ten days or a fortnight before you would get the majority of the people inoculated?—Yes.

4016. Do you find prejudices against inoculation among particular classes?—Muhammadans, as a rule, are much slower in taking it up than others.

4017. Do you find it necessary to have Lady Doctors for inoculating the women amongst the Muhammadans?—In Madras there is a Lady Doctor who is doing that.

4018. Would you give us any information you may possess with respect to the protection conferred in inoculations? I believe you inoculated at Daman or Belgaum?—I inoculated at Belgaum.

4019. Did you get any statistics there?—No; I wired for statistics with regard to the regiment that was done there, but unfortunately they have not arrived up to date.

4020. Can you tell me whether only one regiment was done there?—Only one. The details of another regiment were done—21st Pioneers—at the depôt at Belgaum; but the regiment itself was up at the front. Nearly the whole of the 26th Regiment of Madras Infantry was done. If I remember rightly a few of the Muhammadans in whose company no plague occurred were not done: but the great majority of the regiment was done, men, women, and children.

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4021. But you do not know the exact facts—you do not know the result. Have you any other facts beyond those which we have had from M. Haffkine with regard to the effectiveness of inoculation in addition to the Undhera experiments?—I can tell you of the case of a child. At Belgaum I was living with Major Forman of the Royal Army Medical Corps, and we inoculated all the people living in his compound—all his servants. There was only one child in the compound that was left uninoculated, and that child died a fortnight after of plague.

4022. Why was it left uninoculated?—Because the father refused to bring it up on the two occasions when we inoculated. This child was the daughter of a syce. On the first day when we inoculated, the syce said that the child was asleep, and that he could not wake it up. On the following evening when we inoculated, the syce made some other excuse: anyhow the child was not done; and that was the only case in the compound, and it was fatal.

4023. Was the child a sickly child?—There was nothing the matter with the child.

4024. Have you any opinion as to whether the inoculations begin to protect within 24 hours after they have been done?—I think after the first 24 hours.

4025. I believe you have had experience of fighting plague by means of disinfection: have you any experience bearing upon the disinfection of houses, or does your experience relate only to the disinfection of travellers?—I have no experience of the disinfection of houses.

4026. Your experience relates to the disinfection of travellers and their effects?—Yes. I have never personally done it myself, but I have seen them disinfected. I have seen it done in the Bombay Presidency.

4027. Will you tell us what methods of disinfection you have seen employed for travellers, and whether they are effectual in your opinion, or not?—The best method I saw was at Poona, where they had a very elaborate arrangement. They had hot water for bathing the passengers. All the passengers arriving by train were taken out of the train and put into an enclosure where there was a shed. In this shed they changed their clothes. The clothes they came in, were taken off, and fresh clothes given to them in the camp. They then went to the bath-room, where they bathed in wooden tubs, in which phenyle or some similar disinfectant was mixed in the proportion of 1 in 100. The passengers threw this water over them, and washed themselves in the usual way; and then they dressed in the clean camp clothes: their old clothes and the luggage they had with them having, in the meantime, been disinfected by means of steam. When taken out of the steam disinfector, their old clothes were given them, the camp clothes reclaimed, and they were then sent into the detention camp.

4028. Have you formed any opinion as to the effectiveness or ineffectiveness of this disinfection of travellers?—I have no facts.

4029. Have you any experience of segregation, as a method of fighting plague?—No, except what I saw in Bombay. I think it was carried out on an utterly inadequate scale in Bombay.

4030. Can you give us any facts to show that it was inadequate,—that it was not a useful method of fighting plague? Have you, for instance, formed any estimate of the proportion of contacts removed to the number of cases?—I have the figures here. As an example, let us take the first 15 days of March. I take March because it was only then that a note was made in the Municipal Office of how many plague corpses were burnt and buried, without any information being obtainable as to the locality they were brought from, or when it was found that a wrong address had been given. In these cases then the authorities could not find out the house from which a plague case came, and therefore could not carry out any disinfection or segregation of the inmates. I take 15 days only because these figures were made out at the end of March, and I left Bombay soon after. I do not know what has happened since then. I can read out the figures if you wish.

4031. I understand your case is this, that there were a great number of plague cases, and a certain number of segregated people, and they did not correspond with the number of plague cases?—There was only one contact for every four plague cases according to my figures.

4032. Will you give us the figure?—I copied the figures from the Municipal Mortuary Register in the Municipal Office at Bombay. I have a rough copy with me if you care to see it.

4033. Can you tell us how many plague cases you estimated to have occurred in that fortnight?—As an example let us take the first fifteen days of March, and we find that in this time 2,243 attacks and 2,513 deaths from plague were registered. Of these, 588 attacks and 188 deaths were among people whose residence was not discovered, so that it was impossible to segregate any one from their houses. But if we deduct from the total mortality, which was 4,620, the average normal mortality of the city, at 70 per diem, we get (4,620—1,050) 3,570 deaths as the true plague death rate for these 15 days. But only 2,513 such deaths were reported; therefore (3,570—2,513) 1,057 deaths from plague occurred which were never discovered. Each of these deaths represents one case of attack not discovered, and these added to the number of reported attacks whose residence was not known (1,057+ 588), give a total of 1,645 cases of plague whose residence was not discovered, and from whose houses in consequence no contacts could be removed. The total number of attacks, whose residence was known, was (2,243—588) 1,655, or only ten more than the number of unknown cases. When it is considered that for the 1,057 unreported attacks that ended fatally, there must have been about 20 per cent. of attacks ending in recovery, and which were also not reported, we see that really less than half the number of plague cases were ever discovered by the Plague Committee.

4034. Are you sure that there was no other epidemic in Bombay except the plague?—I am not aware that there was any other epidemic. I asked the Health Officer, and he said there was none.

4035. (*Mr. Hewett.*)—In paragraph 3 of your précis of evidence you state the mortality at Undhera from plague from the date of the inoculations, *viz.*, 12th February 1898; will you put the figures in your evidence?—The following table will give the particulars:—

Ages.		Inoculated.		Uninoculated.	
Five years and under	Males	4	=13	5	=11
	Females	9		6	
Between 6 and 59 years inclusive.	Males	34	=54	19	=53
	Females	20		34	
Sixty and above	Males	3	=4	1	=3
	Females	1		2	
TOTAL			71		67

4036. So far as possible the uninoculated were persons who corresponded to the inoculated?—Yes, living in the same house.

4037. You endeavoured to distribute the population pretty equally according to condition and age?—I think the figures show that they were distributed pretty equally. The males and females are also shown, and the general condition of health. There were slightly more males than females.

4038. The general condition of health?—As far as I could see they were all the same, and no attempt was made to avoid operating on weakly or unhealthy persons.

4039. In the ensuing weeks between the 12th of February and 25th of March, the village was left to itself?—It was.

4040. When you conducted the inoculations, you had a census made of each house infected?—Before we went there a complete census had been made of all in the village by the authorities of the Baroda State.

4041. The people were marked off on the census paper?—Yes.

4042. Therefore you had an accurate record of the persons inoculated?—Yes. We marked down opposite each man's name how many c. c. he got.

4043. During the period of your absence there were only eight cases of plague: were they deaths or attacks?—Attacks: there were three deaths among these.

4044. Eight cases among 71 inoculated persons?—Yes.

4045. During the same period how many attacks were there among the uninoculated?—Twenty-seven, with 26 deaths: that is, excluding the three that occurred on the first day after inoculation. They were excluded as people who were probably already attacked with plague. that

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altogether there were 30. The following table will show the figures :—

During the week ending.	Cases among the inoculated.				Cases among those not inoculated.				Deaths from all other causes.
	5 and under.	6 to 59.	60 and over.	Total.	5 and under.	6 to 59.	60 and over.	Total.	
19 Feb.	...	...	...	...	2	8	...	10	...
26 „	1	5	2	8	1	11	...	12	1
5 March	...	...	...	...	1	3	1	5	...
12 „	...	...	...	...	...	...	...	...	...
19 „	...	...	...	...	...	1	1	2	...
26 „	...	...	...	...	...	1	...	1	...
TOTAL .	1	5	2	8	4	21	2	30	1

4046. Had you to depend upon the statement of the people as to the plague attacks?—There was a Medical Officer there.

4047. Of what standing?—He was either a Hospital Assistant or an Apothecary, I am not sure which.

4048. Was he a man who would possibly make a few mistakes, but not more than a few?—I should fancy so. He was living on the spot all the time, and he had knowledge of how the people were treated.

4049. He kept a record of the deaths?—Yes. We went round to every house where a case had been, and we took a census. We called the people out from each house.

4050. You excluded every possible error in this respect?—I had the census paper in my hand, and I called them out myself. Surgeon-General Harvey was with us.

4051. So that so far as the experiment was concerned you are satisfied that the results are as accurate as if they had been taken under your own observation?—Yes, I think so.

4052. Did you inoculate in Calcutta?—Only a few cases.

4053. You found the people averse from inoculation?—No one came for inoculation while I was there.

4054. Why was that?—I do not know. No one was trying to persuade them to be inoculated. No one gave them information. I was in Calcutta inoculating, after the riots took place.

4055. When did you get to Calcutta?—I got to Calcutta on the 19th of May. The riots were on at the time, and I went to Darjeeling: I remained six weeks and then I returned to Calcutta. I only did half a dozen cases in Calcutta.

4056. Plague was in existence the whole time?—It was.

4057. But the people did not come forward?—No; the disease was not in the epidemic form. There was only a case here and there.

4058. I understood you to say that M. Haffkine recommended second inoculation: I thought he only recommended second inoculation when the reaction did not go up to 102?—I am only judging by the evidence I saw in the paper the other day.

4059. Is not there a list of instructions issued by M. Haffkine?—Yes.

4060. What does he say in them?—When I left Bombay his opinion was that one inoculation was sufficient,—taking that Undhera experiment as evidence. There was only one inoculation done there.

4061. Do not his instructions, which are circulated by him, prescribe one inoculation?—I am not sure. I have not a copy of them here.

4062. Do not you think that it is calculated to make inoculation unpopular if a second inoculation is insisted upon?—I think probably—yes.

4063. Do not you think that the fact that these bottles are issued from M. Haffkine's laboratory,—one sent with a dose of 12½ c. c., another with 10, and the next one with 2½—is calculated to embarrass the people who are inoculating?—It is embarrassing, but the method being a new one, and medical men being rather cautious in using new remedies, I think they will be careful in looking at the dose upon th bottle, and making calculations accordingly.

4064. Do you not think it important that the bottles should contain uniform doses, if possible?—It would be excellent if that could be so.

4065. Do you see why it should not be so?—You had better ask Dr. Haffkine that, I think.

4066. You have not given figures as to the civil population in Belgaum; did not you inoculate in Belgaum on a somewhat large scale?—I have only rough notes here in my note-book.

4067. You cannot give figures as accurate as the figures from Undhera?—I only know the numbers I inoculated.

4068. I should like to know how many you inoculated?—I can tell you roughly,—among civilians, 1,096.

4069. A very large number were inoculated at Belgaum?—A very large number.

4070. The number which you inoculated forms only a portion of the total?—Some thousands were inoculated. I do not know how many.

4071. They readily come to be inoculated?—Yes.

4072. The general impression was that it was advantageous to be inoculated?—Yes. People were crowding up to be inoculated.

4073. (*Dr. Ruffer*).—Of the 1,096 people you inoculated in Belgaum how many did you see after inoculation?—I do not suppose I saw any of them.

4074. Did you not say that in your opinion no evil effects followed inoculation?—Yes.

4075. If you did not see the people again, how do you know there were no evil effects?—By receiving no news. As a rule, they would be only too ready to tell you. That is the only way in which I can tell.

4076. By receiving no news?—Yes. We do such a number in one day that it is impossible to visit them.

4077. I am only asking for information. How many people do you think you could inoculate in a day? What is the maximum that you have done in a day, for instance?—I could not tell you: I do not know.

4078. Do you think you could take 500 people in a day?—I think so.

4079. We have had it before us that a lady did 800: you think that 500 would be a fair average?—Yes. Of course proper arrangements would have to be made beforehand for recording names, and filling up certificate forms. There would then be only the mechanical act of putting in the needle. You can easily do it 500 times. You would have to have people to write the papers.

4080. Supposing there is a village of 4,000 inhabitants in which you think plague is likely to break out: do you think a man could inoculate 500 people a day?—Certainly, if the people were willing.

4081. We will assume the people to be willing: you think it would take ten days before you could bring the people up to the scratch?—As a rule.

4082. So that it would take 18 days before the people were inoculated?—Yes.

4083. I suppose you must reckon two days at least for the period of incubation?—Yes.

4084. So that it would be 20 days before the people were sufficiently protected?—Probably.

4085. Supposing there were an epidemic in a village such as you have just mentioned, two deaths from plague per day would be a good average?—I should think it would be a good average.

4086. Not too high an average?—I could not say,—I do not know.

4087. You mentioned a village in which you had found 30 people had died out of 67: I am therefore taking a very low average?—Yes.

4088. So that 40 people would have died before the inoculations could be performed, or have had their effect?—It would not probably be so many as 40, because people are becoming protected by the operation, in increasing numbers day by day.

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4089. I will allow for that by taking 10 instead of 20 days: so that at any rate 20 people would have died of plague in a village of 4,000 inhabitants before the inoculations could have produced any effect?—Yes.

4090. (*The President.*)—Have you any facts to show what was the duration of protection?—I have only hearsay evidence.

4091. Did you follow your cases sufficiently to know or observe what reaction was produced by inoculation?—I have seen many cases, of course. I have seen the reaction go to 105°, but I have never seen it go higher than that.

4092. Do you aim at any definite temperature reaction in your inoculations?—102°.

4093. But you had not the means of determining whether that reaction was got or not in the great majority of cases?—No.

4094. Do you think it is an important matter that a certain temperature reaction should be obtained?—I cannot say. It is only theory.

4095. You have no opinion as to that?—I do not think I can offer any opinion upon that.

(Witness withdrew.)

CAPTAIN R. ROBERTSON, I.M.S., called and examined.

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4096. (*The President.*)—I believe you are in the Indian Medical Service and you are the District Medical Sanitary Officer at Anantapur?—Yes.

4097. (*Mr. Hewett.*)—How long have you been stationed at Guntakal?—Since the 3rd of September this year.

4098. It is a disinfection and medical inspection station, is it not?—Only a medical inspection station.

4099. Between what lines is Guntakal a junction?—It is a junction between the Southern Mahratta and the Madras Railways.

4100. Where the narrow and broad gauge meet?—Yes.

4101. Were you employed on the medical inspection there?—No; I have been mostly employed in the treatment of plague in the villages.

4102. Is there a separate officer for medical inspection of passengers?—Yes.

4103. Before you came there had any people been taken out of the train suffering from plague?—There has been about six cases of plague before I went there.

4104. Do you know when they occurred?—The first was picked up about the 14th of August this year in the railway station.

4105. Were these cases last year?—I could not tell you. Major Hakim will probably tell you about that. There was an imported case about the 14th of August.

4106. Where did the man come from?—It is very doubtful how he got plague. It was rumoured that he had come from Hubli: but the man denies ever having been out of the station for three months before.

4107. Did he die?—No, he is alive.

4108. What was the next case?—The next case was in the railway contractor's house. He lost two sons from choleraic symptoms before anything was known.

4109. Were these cases of plague?—Yes.

4110. They were not seen by the medical officer?—No.

4111. What was the next case?—The next case was that of a brakesman on the Southern Mahratta Railway. He came from Bangalore, and the fact was telegraphed to Bangalore, and two people were found in his house with plague.

4112. When did that case occur?—I think towards the end of August.

4113. What was the next case?—The next case occurred in a native merchant's house alongside the contractor's house. He had several cases in the house.

4114. Had these people been out of Guntakal?—No.

4115. Had the contractor been out of Guntakal?—No, but the contractor was always receiving people from Hubli.

4116. The contractor's case and the case in the next house were apparently indigenous cases?—Yes.

4117. Did other cases there occur?—The native merchant took it down to Timmencherla.

4118. How far from the Junction?—About a mile.

4119. How big is the village of Timmercherla?—There are about 200 houses,—about 2,000 people.

4120. Before dealing with Timmencherla, I will ask what measures you took at Guntakal?—I was not there in time.

4121. When you arrived, had the disease got to Timmencherla?—It had not quite got there: there were a number of concealed cases before I actually discovered it.

4122. What measures did you take in the village of Timmencherla?—I took the people off to the Government camp, and disinfected their houses.

4123. Did you evacuate the whole village?—Not at first.

4124. What portion of the village did you evacuate first?—I evacuated each house, and the houses on either side, until the place began to get dotted throughout a certain area, and then I had that area evacuated.

4125. Did you eventually evacuate the whole village?—No, just that block.

4126. Is it still evacuated now?—They went into it about a fortnight ago.

4127. Has plague stopped in the village?—Yes.

4128. How many cases were there altogether?—There were about 50 cases altogether.

4129. How many of these took place while you had the contacts in the segregation camp?—From Timmencherla I do not think any contacts developed plague.

4130. No cases of plague developed in the camp after you evacuated the place?—No.

4131. They have all gone back again now?—Yes; they have all gone back again now.

4132. Did the disease spread anywhere else?—Yes. From this merchant's house in Timmencherla one of the people went off to the village of Guntakal, about a mile further on, and she got ill there and died.

4133. What is the size of Guntakal?—It is a place having about 800 houses and there are about 5,000 inhabitants.

4134. Did the case you speak of come to your notice at once?—No: it was about 3 weeks afterwards.

4135. Had other cases occurred too by that time?—Yes.

4136. How many cases were reported?—There were no concealments in this second village at all.

4137. But you did not hear of this case until 3 weeks afterwards?—It was the only case; but they did not know it was plague.

4138. When it came to your notice 3 weeks afterwards what else did you ascertain?—Two cases had died in the interval.

4139. And there had been no other abnormal mortality?—No; but just before this occurred a rumour reached me that a large number of rats were dying in Guntakal.

4140. Did you go to Guntakal?—I was going there twice a week for inoculating.

4141. When these three cases had occurred in Guntakal, did you evacuate any portion of the village?—No.

4142. Did the plague die out of its own accord?—No; I disinfected and removed the people in the adjoining houses. I disinfected the houses, and waited. The people were removed to the Government camp.

4143. Did you not remove persons from those houses in which cases had occurred, and the neighbouring houses: I want to know how much of the village you cleared out in the first instance,—before you finally cleared the whole village out?—I should think about 80 houses.

4144. Did you find that this did not stop the outbreak?—It was still going on. The disease kept creeping on along the village. A few people still got plague about the village and I determined upon evacuating the whole village.

4145. How long did it take you to evacuate the whole

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village?—It took a considerable time on account of the Muhammadans giving trouble.

4146. You got the whole 5,000 people out into the camp eventually?—Yes.

4147. When they were in camp, in segregation, were they permitted to go into the village at all?—No.

4148. Neither into Timmencherla nor into Guntakal?—No.

4149. How long did it take before you got the disease under control in Guntakal?—About two months.

4150. Has it died out there now altogether?—No. There are still a few cases about the fields. The people have all gone off to their own fields.

4151 You have let them out of the segregation camp?—There has been no real segregation camp except for the Musalmans. They had made their own huts in their own fields.

4152. How do you ensure that they shall not get back into the village when they are in their own huts?—There is a police guard.

4153. Of how many men?—There are about 6 men in the special guard; and there is the ordinary village guard.

4154. Do you think that is sufficient to ensure that nobody goes back into the village?—Yes. I think so.

4155. The only persons you had any difficulty in getting into the camp were the Muhammadans?—Yes.

4156. How many of them had you in the village?—Very nearly 300.

4157. Did you have any cases of plague among them?—Yes.

4158. How many?—We have had one case in the camp to my knowledge.

4159. During the two months you had them under observation?—They have only been in the present camp about a fortnight.

4160. Why did you put the Muhammadans in this camp, while other people were allowed to be about in their own camp?—Because the Muhammadans would not go out of the village.

4161. That was the only way in which you could evacuate their quarter?—Yes. The Hindus went out quickly enough, but the Muhammadans would not go out until we issued summonses on a number of them. Then they saw they would have to go out.

4162. How long did it take to make the evacuation of the whole village effective?—From the beginning, about two months: because there was a partial evacuation at first, and then there was a complete evacuation.

4163. The partial evacuation extended up to 80 houses, and then you determined to evacuate the whole village?—Yes.

4164. From the date you determined to evacuate the whole village, how long did it take before you could get the people out?—About a month.

4165. And that delay was due to the Muhammadans declining to go out?—Yes.

4166. Have you had any more cases at Guntakal Junction?—Yes. There is a small village a few miles away on the other side, and four miles from Guntakal village, where they have had nine cases, two days ago.

4167. Have you traced the source of infection in that village?—About three weeks ago there were three plague cases there in one house. They died within five days of each other. On the tenth day, on getting there, I found a girl had died. The people belong to a class which necessitated their keeping to themselves: they could not mix with the other people in the village. I had this remaining girl buried. I burned down the house, and dug up the floor; and there was no more of it for about 15 days or 3 weeks. Then there was another case, and just at this time there was a rumour that a large number of rats were dying in this village. The people in five of the houses went out themselves. I gave them tents and they went out. Yesterday I got a telegram from the Deputy Collector there stating that there were 9 attacks and 3 deaths in this village.

4168. Did you trace the infection of that village to one of the other villages?—The first case was that of a man who was a stone-cutter. He used to come about to Guntakal Junction looking for work, and it is very likely he took the disease there from Guntakal Junction or the village.

4169. Did you observe rats both in this Guntakal village and this third village?—Yes.

4170. Did you see many of the myourself?—In Timmencherla I saw a considerable number.

4171. Did you see any before the people began to be infected?—No; but I heard it on good authority before the real outbreak occurred in Guntakal village that rats were dying there.

4172. Before there were any plague cases?—Beyond that one I told you about—the first case.

4173. You are satisfied that there were rats before the plague broke out?—Yes. The Tahsildar made an enquiry which confirmed the fact.

4174. (*Prof. Wright.*)—Do you say before the first case of the outbreak?—In Guntakal village, between the first outbreak, which was unknown, and a case which happened about 3 weeks afterwards, a number of rats had died.

4175. (*Mr. Hewett.*)—There was no rat epidemic before any case occurred?—The first case was introduced from Timmencherla.

4176. Still it was introduced. The infection was there. There was no rat epidemic before the introduction?—No.

4177. So that you have no evidence from these three villages which shows that the mortality amongst the rats preceded the attack upon the people?—No.

4178. They may be concurrent?—Yes.

4179. How many people did you inoculate in these villages?—About 350 in Timmencherla; but I only began inoculating there after the epidemic had thoroughly started—about half way through the epidemic. In Guntakal I inoculated about 500 or 600.

4180. Did you keep an accurate register of the inoculated people?—No.

4181. You have no facts which show how the disease attacked uninoculated and inoculated people, respectively?—I have got a few facts as to who the inoculated people were and the inoculated people who contracted plague.

4182. Have you any facts which would contrast the liability of uninoculated and inoculated people respectively to get plague?—No.

4183. Can you tell us how the disease was arrested at Guntakal Junction?—At Guntakal Junction the whole place was cleared out. The Railway Quarters were all cleared out, the houses were thoroughly disinfected, and there have been no more cases there.

4184. You had those six cases, but no more?—No.

4185. I suppose the officers employed on medical inspection not infrequently take out plague cases, or suspected cases, from the train?—Sometimes.

4186. Guntakal Junction is free now?—Yes.

4187. And you think your measures at Timmencherla have been effective in stamping out the disease at that place?—Yes.

4188. It is not actually stamped out in Guntakal village?—A few deaths are being reported from the fields.

4189. (*Prof. Wright.*)—Were there many plague cases occurring at Timmencherla when you went there: was the mortality decreasing?—It was rather increasing.

4190. Were you able to control the deaths that occurred in the huts outside, or were they scattered all over?—They went to a health camp: they all went together.

4191. You had no more difficulty in finding out where the deaths occurred?—There were no deaths at all. The people did not want to go back into the village.

4192. It looks as if nobody was incubating plague: have you an explanation with regard to that?—I have no explanation.

4193. Have you any facts bearing upon the incubation of plague?—No.

4194. How long did it take to evacuate the place?—Two months.

4195. And did the two people you mentioned not return to the village in the meantime?—There was a partial evacuation. You could not get into the village because there was a police guard over it.

4196. This is the village where there were both Hindus and Musalmans?—Yes. There was a block of 80 houses evacuated first. When that block was evacuated they could not get into it: there was a guard over it.

4197. These later cases of plague cannot have infected themselves in the village: they must have infected themselves

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from the other cases occurring in the huts?—I think they got infected in the village. There were a number of concealed cases, especially about the Muhammadan quarter. They would not tell when one of the family died. They would take the body out at night and bury it.

4198. The later cases may have infected themselves, by coming in?—Yes.

4199. (*The President.*)—In this village the Muhammadans were not segregated earlier?—They were the last to leave the village.

4200. While they remained in the village did plague cases continue to occur?—Yes.

4201. You ultimately succeeded in having them segregated and kept under inspection in the Government camp?—Yes.

4202. What was the history of the plague after that had occurred amongst these Muhammadans?—There is only one case I know of since, and that occurred last Friday.

4203. Immediately before segregation was adopted, were cases occurring in the village?—Almost every day.

4204. No further cases have occurred?—Not since last Friday.

4205. They have not returned I suppose?—There have been no cases.

4206. They have not returned to the village?—They cannot get back into the village. They are all in huts now.

4207. In how many villages did you effect complete evacuation of these you have been speaking of, one or two?—In one village I was able to effect complete evacuation, and in one village partial evacuation.

4208. Were those who were left kept under observation?—No body lived in the village.

4209. Were those who removed themselves kept under your observation?—No, they went to their own fields, and erected huts there.

4210. Have cases occurred amongst them?—Some cases have occurred.

4211. Do you know if they have occurred at the same rate as they were occurring before?—Much less.

4212. Have you got the figures?—I have only got my note-book showing the number of deaths. I could produce the figures, but I have not got them here.

4213. Could you produce the figures with reference to each of these villages?—I could produce the figures with regard to Guntakal. In Timmencherla village there were no deaths after evacuation.

4214. Will you give us the figures and details with regard to the cases which occurred before evacuation?—Yes.

4215. (*Prof. Wright.*)—You have the names of those you inoculated?—Yes.

4216. And a list of the deaths which occurred amongst the inoculated, a list of all the deaths, and the number of the deaths which occurred in the village?—Yes.

4217. Can we get the number of deaths among the uninoculated and among the inoculated, for the purposes of comparison?—Yes.

4218. (*Mr. Hewett.*)—Perhaps you will give us the figures we want at Guntakal?—Yes.

4219. And perhaps you could show us those villages the day after to-morrow?—Yes.

(Witness withdrew.)

LIEUTENANT J. W. CORNWALL, I.M.S., called and examined.

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4220. (*The President.*)—I believe you are Health Officer for the Madras Municipality?—Yes.

4221. What are your medical qualifications?—M.B., Cambridge.

4222. (*Dr. Ruffer.*)—I believe you have had much experience as to the way in which the system of passports has been applied in Madras?—Yes, I have.

4223. I think you have had a considerable number of passports issued?—I have issued about 5,500.

4224. Could you tell me how many people did not present themselves after the passports were issued?—About 114.

4225. Do these passports refer exclusively to the railway traffic, or do they refer to the railway and to the road traffic?—The passports we issue are railway passports only; but we get duplicates sent to us of the passports that have been issued on the roads by the District Officers.

4226. Do you think there is much evasion in taking passports?—Not on the railway.

4227. On the roads?—On the roads it is possible: I cannot say.

4228. Is it your impression that there is considerable evasion or little evasion on the roads?—There have been a certain number of people coming in who were found not to have taken out passports.

4229. Greater than on the railways?—On the railway, I think all take passports.

4230. You are entrusted with the surveillance of people after they come to the town?—Yes.

4231. Can you give us any details as to the way in which you perform this duty, and as to the results of this measure?—Formerly when surveillance only was the rule there was no responsibility resting on the individual at all. The man came in and had his name and address taken at the station. He went away and if he gave a false address, the probabilities are that he escaped observation altogether. If he was a disreputable person, or the Plague Staff thought he was lying, he was either detained at the camp at the railway, or else he was sent into the town in charge of a peon who followed him about until he found some definite address. A very large number of people arrive who do not know where they are going.

4232. I understand from you that this method has been given up?—Yes; in favour of the passport system.

4233. Has this method been given up because it was found to be insufficient?—Partly because the passport system was introduced all over the Presidency, and it seemed a pity that Madras should not follow.

4234. Will you describe to us how, under the present passport system, you watch the people after they come into the station?—It is their duty now to present themselves at one of the offices in the district in which they live, for ten days after they have arrived in the town. If they do so, well and good. Their passports are signed by the officer, and then returned to the Head Office in due time. If they do not turn up on any particular day, the Plague Inspector goes to look for them. The Plague Inspector goes to the address which is written on the duplicate passport, and looks for the person. If he finds him, he makes enquiries why he did not turn up, and if no good reason is given, he is prosecuted. If he is ill, a report is made, and a Sanitary Inspector or Hospital Assistant goes to see him and reports his condition to me.

4235. Does the Inspector find them in the majority of cases?—In the majority of cases he finds them.

4236. Do you think it is a difficult system to apply, or an easy system to apply?—It was difficult in the beginning, because it is so far-reaching, and so many details have to be attended to. It is working smoothly now.

4237. Still you have a minimum number of about 2 per cent. of people who do not present themselves?—Who not only do not present themselves, but who cannot be found at all.

4238. Are there a certain number of people who do not take passports?—Possibly.

4239. You have had some experience in dealing with plague at Karachi for 15 months?—Yes.

4240. And you have had some experience as to quarantine measures for passengers wishing to enter Karachi?—Yes.

4241. How was the quarantine applied in Karachi?—The Bombay passengers by sea were detained in a large camp, and they were kept for varying periods in the camp—usually ten days.

4242. Were they disinfected?—They were disinfected.

4243. How?—Their clothes were either boiled or disinfected with Jeyes' fluid.

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4244. What strength ?—The strengths were variable. It was left to the discretion of the people doing it. It may have been any strength.

4245. You had no fixed standard of strength ?—No. Enough was poured in to make the water thick and milky.

4246. Who supervised the disinfection : was he a medical man or not ?—I cannot tell you the details. I was not in charge of this camp myself.

4247. So that you have no particular experience ?—Except from casual visits.

4248 You do not know whether a great many people escaped quarantine ?—No.

4249. Have you no knowledge of what occurred ?—Simply what I have heard in the town, that people did run away. There were a number of cases of people coming to the camp and pretending that they were visiting their friends in quarantine. The quarantine people would then go out into the town and the friends live in the camp for a day or two.

4250. It was not efficient ?—It was not efficient in that way.

4251. Have you any experience of quarantine in Malir ?—Yes.

4252. There was the same state of things there ?—No, that was a place in the jungle. It was the railway detention camp, and was used for two purposes,—first of all when plague was in Karachi, to prevent people getting up-country, and secondly when Karachi was free, and there was plague in Kotri, to prevent people coming down.

4253. On the whole you think quarantine is a difficult system to apply, and not an efficient one ? - Yes ; I do not think it is very good.

4254. I suppose you had no difficulty in applying quarantine to passengers coming by steamers ; but I understand there is a great deal of traffic in small boats from Karachi to other parts of the coast ?—Yes.

4255. Did you have any difficulty in finding out where those boats came from ?—I do not know anything about that.

4256. What is your experience about railway inspections and camps : I think you have had a great deal to do with that ?—I have inspected trains at Malir and at Karachi itself, but I have never discovered anybody who had plague. Of course at that time the plague was in Kotri, and there were only a few passengers travelling.

4257. How many passengers do you think you inspected ?—I was doing Railway inspection off and on for six months, I could not tell you at all,—many thousands.

4258. How did you inspect them,—by feeling their pulses ? – One judges more by the appearance of the passenger than anything else. At any rate I did not let any cases in there.

4259 Did you examine them for buboes ?—Not unless I suspected anything.

4260. So that the large majority of people were inspected by feeling their wrists, and looking at their general appearance ?—Yes.

4261. In the railway camps, did you find that any people escaped,—disappeared ? – A few,—a very few.

4262. A certain number did escape ?—Yes.

4263. Did you find cases of plague in the railway camps ?—Yes, there were a few.

4264. How many, do you think ?—When I was at the camp, to prevent the cases getting out of Karachi, we got a few in,—about a dozen.

4265. Out of how many people ?—Thousands and thousands. I could not say how many.

4266. What was your way of dealing with imported cases in Karachi and in other places ? – In Karachi there were no imported cases, as far as I am aware.

4267. In the villages ?—In the villages around the people were isolated as far as possible, and the huts disinfected.

4268. The patient isolated ?—Yes, and the contacts too. The huts, as a rule, were burned down ; or the matting was burned and the rest of them disinfected.

4269. Did you disinfect the contacts ?—When we could. At one time we had no apparatus for doing so.

4270. In small villages I believe you found segregation very difficult ?—Yes ; it did not work very well. That was generally on account of the obstinacy of the people.

4271. You had a great deal of experience with regard to the evacuation of houses ?—Yes.

4272. Can you give us any figures showing the benefits or the reverse of evacuation ?—There was a village of about 3,000 inhabitants in which plague had been going on.

4273. What was the name of the village ?—Kalankote. Plague had been going on in this village for about two months. The people had been segregated and, as far as possible, the contacts had been segregated, but the Muhammadans were very difficult to deal with. Eventually, they were all turned out, and made to live in a healthy camp ; and from that day there were only two or three cases, and they occurred during the first two or three days. After that there were no further cases except one or two which were imported from infected places.

4274. These people were under medical supervision ?—They were inspected every day, or every other day.

4275. Have you any other instance ?—Yes ; there was another village in which about 25 or 30 cases had occurred during the week. Gharibabad was the village. The people in that village were all moved out, and from that day there was not a single case.

4276. What was the number of the inhabitants ?—About 1,000.

4277. Was that under proper medical supervison too ?—I think so.

4278. You were there ?—I was there all the time mysel

4279. Did you find that evacuation was possible in tow—in Karachi for instance ?—Oh, yes.

4280. Do you think it gave good results ?—I think it d.., certainly. Comparatively early in the epidemic there was a very large section of the population who moved out.

4281. (*Mr. Hewett.*)—Are you speaking of the first epidemic ?—Yes. A very large number of people moved out. Several thousands had all camped out ; and although they had cases among them, there were not anything like so many as there would have been if they had remained in their own houses.

4282. (*Dr. Ruffer.*)—Plague did not actually stop ?—It was bad in all other parts of the town. There were a large number of imported cases, no doubt.

4283. When you evacuated a house or street or quarter in Karachi, did you find that you got everybody from that street or quarter into the evacuation camp ?—It was not done while I was in Karachi itself except this one camp.

4284. Did they evacuate houses or whole streets ?—In this case it was a sect—people called Nasarpuris, who were living all over the place. They all left their houses, and came to live in this camp.

4285. Did plague ultimately stop in that camp ?—Yes.

4286. Before the epidemic stopped in Karachi ?—I think it was shortly before.

4287. Not long before ?—Not long before.

4288. In the villages you speak of, were the people allowed to go back to the village to fetch things, or were they completely cut off from the village ?—When they left their houses, they took all their possessions with them. They might have gone back if they liked, but as a matter of fact I do not think they did so. They had nothing to induce them to go back. The roofs were taken off the houses, and they were disinfected. The people could not live there.

4289. Did they communicate with other villages around ?—To a slight extent no doubt.

4290. Were people allowed to go out with passes ?—They were absolutely free.

4291. But they always came back : they did not try to leave the place ?—No.

4292. You believe that evacuation may be useful in the beginning of an epidemic ; do you think it is of any use in a town after an epidemic is once firmly established ?—If it was a thickly populated area which was infected, I think it would be of the utmost importance to evacuate that area and to move out all those people, and put them into a health camp.

4293. Do you think it is possible ?—Yes.

4294. Would you want to use very much force ?—No. I think the people with a little persuasion would move out of their own accord, provided they see they would be absolutely free, and that the new huts would be comfortable, I do not think there would be any difficulty.

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4295. Have you any evidence as to the plague being carried to Karachi or other places by goods ?—I have only ideas.

4296. You have no facts ?—No.

4297. In your opinion, from what you have seen, do you think that the disinfection of houses is a useful measure ?—I think so.

4298. What do you think of the disinfection of persons ?—I do not think it does any good, and the people object to it very strongly. The solutions which I have seen used for the purpose are too weak, I am sure, to do any good ; and the time spent in the fluid is very short. If I had anything to do with it again, I should substitute a plain bath of soap and water.

4299. What solutions did you see used for that ?—Phenyle—Jeyes' fluid.

4300. What strength ?—No particular strength. As a matter of fact it was very weak I believe. The water was only just tinged with it, made milky by it. A strong solution stings the skin in particular parts of the body, so much so that the people cannot stand it.

4301. Did you disinfect with perchloride of mercury ?—No.

4302. Are the people who are disinfected naked or are they in their clothes ?—They had a rag on.

4303. I suppose the women were disinfected in their clothes ?—The women were sent into a little hut and bathed by a female. They were supplied with clothes.

4304. Were they bathed or simply dashed over with the fluid ?—They were made to sit in the tub, and they had the disinfectant poured over their heads. They were thoroughly wetted.

4305. Was any provision made for disinfecting the axilla or groins of the patients in which they might have suppurated buboes ?—No. They were looked at to see if they were thoroughly wetted. If the disinfectants were strong enough to kill the bacillus, they would hurt the people to such an extent that it would be impossible to apply them—that is to say Jeyes' fluid and carbolic fluids.

4306. In the case of perchloride, you might run a risk of poisoning them ?—You might.

4307. If you use them of such a strength as they are used as antiseptics ?—A person would have to sit in the bath for a long time, and it would not be practicable.

4308. Do you think a bath of soap and water would answer ?—It would answer all purposes.

4309. Is it not a fact that the Convention of Venice has given up the use of antiseptics for human beings ?—I do not know.

4310. Did you find in the epidemics in Karachi and other places that a great many children died after the epidemic was over ?—It was the case.

4311. Could you give us the reasons for that ?—Children under five are certainly less liable to plague than those of older ages—babies especially. There were a large number of babies left orphans. There were only a few people to provide for them, and the consequence was they died of starvation, or, at any rate, they died of intercurrent diseases such as diarrhœa and other things.

4312. Do you think the mortality among the children was very much higher ?—It was very high.

4313. From that reason ?—Yes.

4314. Have you any facts bearing upon the incubation period of plague ?—I have a few cases.

4315. Could you give us the cases in evidence ?—I cannot give you the exact dates. I can only tell you between what days the infection must have taken place. There was one woman in whom the incubation period was more than three days, and less than five days.

4316. How do you judge of that ?—She was living in a camp in which there was no plague, and there was no reason why she should have become infected. She came into the hospital to nurse a friend of hers, with whom she had had no previous communication for some weeks. This person came in from a different part of the town, and died within two days. Therefore she must have taken the infection during those two days. She fell ill three days after the person died : so she must have become infected at some period more than three days and less than five days. Judging in the same way from other people,—there was a woman who must have been infected between three and six days, and another between five and seven days.

4317. What are the facts ?—They are similar cases.

4318. (*The President.*)—What do you mean by "similar." You had better give facts. These are very important ?—A person was in hospital and died after being there two days. Another person was brought in to nurse him and look after him : she came from an absolutely uninfected place. This person was therefore exposed to infection during the period in which she was in contact with the sick person,—that is for two days.

4319. (*Dr. Ruffer.*)—I take it that she came from a part of the town where there was no plague ?—Where there was absolutely no plague. She fell ill on the third day after this person died. Suppose she had been infected when she came in contact with this man, the incubation period would have been five days, 3 + 2. Supposing it was just before his death, it would have been only three days. That is the first one. All these cases are exactly the same,—either a woman or a man coming in from an uninfected place to nurse a patient of some sort in hospital. We had no nurses in these hospitals.

4320. So that the first case was three to five days ; the second three to six ; the third five to seven and the fourth two to six ?—Yes. And there was one more case in Madras a short time ago. Two in a family got plague, and the rest of the family were segregated. On the ninth day another member of the family fell ill, although she had had no contact with the patient. The clothes had been disinfected on coming into the hospital, and so presumably her incubation period was more than nine days.

4321. But was there any plague at the time in this segregation camp ?—No.

4322. There was absolutely no plague ?—Absolutely no plague.

4323. (*Prof. Wright.*)—But in these cases the people may have carried the clothes with them and infected themselves later. There is no evidence that three days was the shortest period. You gave the first case of a woman who took plague three days after the death of the first patient. The woman might have carried off the clothes from that patient, and she might have taken the infection from those clothes two or three days after ?—That is possible. As soon as the person they were nursing had died, these people were taken away to the segregation camp, and their clothes disinfected.

4324. (*Dr. Ruffer.*)—Are you satisfied that the disinfection was sufficient ?—Yes.

4325. And you are quite satisfied that there was no infection in the segregation camp ?—Yes.

4326. (*Prof. Wright.*)—That applies to all the cases ?—Yes.

4327. (*Dr. Ruffer.*)—Have you any evidence as to treatment ?—There is nothing of any value as far as the disease is concerned. I have seen strychnine used in very large doses. People will stand very much larger doses of strychnine in plague than I have ever given or heard of being given in any other disease.

4328. Any other drugs,—hyoscine for instance ?—It seems useful in plague delirium.

4329. You have no evidence as to the serum treatment of plague ?—No.

4330. I believe you have made a good many microscopical examinations of the blood of plague patients ?—Yes.

4331. How many examinations did you make ?—About 60 or 70.

4332. Have you ever found the bacillus in the blood ?—I have found it four or five times amongst those cases.

4333. In what patients ?—It was only in those patients who were about to die, within a few hours of death.

4334. Did you attach any great importance to the microscopic examination of the blood in the majority of cases of plague ?—As far as diagnosis is concerned it is absolutely useless.

4335. I take it that when you find the bacillus it is a sure diagnostic sign, but when you do not it means nothing ?—That is so.

4336. (*Mr. Hewett.*)—Is Madras a place liable to sudden invasions from an infected area ?—Yes.

4337. Do you think that the passport system will work satisfactorily in the event of such an invasion ?—I think so. We can increase the staff.

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4338. You think it is the best protection you can have?—I think it is the best means.

4339. How many imported cases of plague have you had up to date in Madras?—Eleven or twelve,—I forget which.

4340. Over what period have they occurred?—Over a period of a month or six weeks.

4341. You had some last year?—That was before I came to Madras. I do not know much about it. That was from Bombay.

4342. During the past six weeks you have had about a dozen cases?—Yes.

4343. What have you done when you have found an imported case?—We have found them in their houses. We have taken the actual patient to the hospital, and segregated the relatives of those cases when we have been able to do so.

4344. Have some of the contacts escaped?—In the first case, they did undoubtedly; but in the other cases, I do not think they did.

4345. You have had no indigenous case?—No.

4346. Up to date your measures have been effective?—Yes.

4347. Have you evacuated the neighbourhood, or simply the infected houses?—Simply the houses in which cases occurred.

4348. Your mortality in Madras has been rather high this year, I believe?—Very high.

4349. Can you compare it with the average mortality?—I cannot give the figures now.

4350. It has been abnormally high?—Very high.

4351. You have not been able to connect the high mortality with concealed plague cases?—No. The matter was investigated very carefully, and we were quite satisfied that plague had nothing to do with it.

4352. There has been no latent plague?—No latent plague.

4353. How do you get the death returns in Madras: do you think they are accurate?—Fairly accurate. The people report a large number of cases themselves. There are peons at all the burial grounds, whose duty it is to report all the cases that come to be buried there. They take down names and addresses of the people, and the disease from which the person was supposed to have suffered. That, of course, merely resolves itself into either fever or cholera, or diarrhœa.

4354. Is the record of the cause of death often inaccurate?—Generally inaccurate.

4355. You spoke about railway inspections: do you think that they are of no use?—I would not say they are of no use, but I do not think they are of very great value. Undoubtedly a certain number of cases are detected.

4356. Would not people who have plague on them or feel out of sorts abstain from travelling by rail if they think they are going to be stopped?—Yes.

4357. The examination has to be made in a very short time, but do not natives, generally, when taken out of the train and made to stand up, show that they are ill if they are a little bit out of sorts?—Yes.

4358. It is not so difficult to detect them?—After a little practice it is easy to detect a sick man.

4359. So that an inspecting officer is not likely to let through any people who are ill or out of sorts?—No.

4360. And most of the dangerous people are stopped?—Yes.

4361. And although the period of incubation reduces the value of medical inspection on railways such inspection does good by stopping sick people from travelling?—Yes, in that way, certainly.

4362. You referred to infant mortality in Karachi: infant mortality is very large indeed over the whole of India, is it not?—It is very high. But this went up very suddenly; it was very noticeable.

4363. Compared with ordinary infant mortality?—Yes.

4364. Can you give us any comparison?—No.

4365. But it was so high as to attract notice?—Yes.

4366. (*Prof. Wright.*)—With regard to the incubation period, I think that you said that the disinfection of persons which you saw carried out was ineffectual?—Certainly. I was speaking of the railway camps.

4367. Had you a different system of disinfecting people who came out of plague hospitals before they were put into segregation camps?—No, the same method was adopted. They were made to sit in a bath of Jeyes' Fluid.

4368. On reconsidering it, do you not think they might have infected themselves at a later date?—It is just possible, though I think it is unlikely. The only way they could have done it would be by carrying the bacillus in their hair or armpits.

4369. They carried no clothes?—No, they carried no undisinfected clothes.

4370. (*Dr. Ruffer.*)—What clinical form of plague do you think spreads the disease most?—The pneumonic form undoubtedly.

4371. And I suppose the septicæmic form?—I do not think so. The people die so rapidly. You mean what I call the intoxicating form, when they die very quickly, without any particular signs at all. I do not see why they should be particularly dangerous.

4372. Do you think the bubonic form, in the absence of pneumonia, can spread the disease?—Except by the evacuations I do not see how it can.

4373. And that only at the end of the disease?—Only at the end of the disease.

4374. In your railway inspections, have you ever as a matter of fact stopped a pneumonic case of plague?—No.

4375. Do you think a pneumonic case of plague could travel?—In the very early stages no doubt.

4376. But not at the late stages?—No, not at the late stages.

4377. (*Prof. Wright.*)—You said you found the plague bacillus in the blood in five cases: were those bubonic cases of plague?—I could not tell you. The cases were just before death. Some were bubonic and some were pneumonic,—I forget now.

4378. (*The President.*)—Have you any instances of people who have been removed to evacuation camps having infected other districts?—I know of no such instances.

(Witness withdrew.)

DR. T. W. ILLINGWORTH called and examined.

Dr. Illingworth.

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4379. (*The President.*)—I believe you are Acting District Medical and Sanitary Officer at Bellary?—Yes.

4380. What are your medical qualifications?—Doctor of Medicine, University of Aberdeen.

4381. (*Mr. Cumine.*)—How long have you been at Bellary?—Since the end of last April.

4382. There have been two or three imported cases in Bellary, have there not?—Two only.

4383. Where were they imported from?—Bangalore.

4384. When they arrived at Bellary they had not, and ought not to have had, any passport, ought they?—They were given a passport at Bellary.

4385. As far as your Presidency is concerned, it is right that they should arrive at Bellary without any passports?—As far as I know it is.

4386. People so arriving are given passports on the Bellary platform?—Yes.

4387. And they are bound to come up at intervals for ten days?—Every day for the next ten days.

4388. That was the way in which it was discovered that they had plague?—It was.

4389. What did you do to them when it was found they had plague?—As soon as the cases were reported they ware removed in a dooly to the plague camp.

4390. And were the people of the house in which they were living all sent into a segregation camp?—Yes.

4391. Did any cases occur amongst the people thus segregated?—None.

4392. Did the infection spread in the town?—No.

Dr. Illingworth.

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4393. I think you have had three villages infected within your jurisdiction.—Yes.

4394. The first was Chipagiri?—Yes.

4395. Is that near any other infected place?—It is six miles from Guntakal.

4396. Was there plague in Guntakal at the time?—For some time before.

4397. How was plague introduced into Chipagiri?—By persons visiting Guntakal and bringing it back with them.

4398. How did you find out that there was plague in Chipagiri?—The Tahsildar of the place sent word in to the District Medical Officer saying that several cases of death were occurring amongst the inhabitants,—very suspicious cases. I went down to examine them, and found it was plague.

4399. Do you remember approximately what that date would be?—The first case I saw was on the 21st of September this year.

4400. Do you remember how many suspicious deaths there had been by the time you got there?—At least six.

4401. Did you find any people ill with the plague?—I found two ill with plague when I arrived.

4402. Did you turn out all the people, did you evacuate the whole village?—We could not do that; we had not accommodation for them. A great many absconded into the fields of their own accord. All the people in houses in which plague occurred, and in the neighbouring houses, were segregated, and those with plague were sent into a Plague Hospital outside the village.

4403. Amongst the people who were segregated, did more plague occur?—Not in the segregation camp.

4404. Amongst the people who had been left in the village, not taken out, did more plague cases occur?—Three more cases occurred, but they had been in contact with other cases who had died previously.

4405. They had been in contact, but you had not got hold of them?—They lived in a distant part of the village.

4406. Did you hear of these three cases promptly?—Yes, as we were visiting houses daily.

4407. Did you remove them?—Yes, at once.

4408. Did you remove any contacts?—Yes, we removed all the people in the three houses, and took their effects outside and destroyed them.

4409. And no further cases occurred in the village?—Not after that.

4410. Had the first cases, which had occurred before these three cases, occurred in one corner of the village or in one block of the village?—They had practically all occurred in one block, the houses were close together.

4411. Did you observe or hear of any deaths among rats in this village of Chipagiri?—We offered a reward of two annas for each rat, but we could not get any rats.

4412. How long is it since the last case occurred at Chipagiri?—I think the last case occurred on the 4th of October.

4413. Are the people still out?—They are in now.

4414. There has been no return of the epidemic?—Not at all since the fourth.

4415. Did you disinfect?—All the people were disinfected before leaving the segregation camp.

4416. Did you disinfect the houses?—The houses were thoroughly disinfected: four houses were burned.

4417. You did not burn down this block where earlier cases occurred?—We were not allowed to.

4418. What did you disinfect with?—A solution of 1 in 1,000 of perchloride of mercury. The things that we could not disinfect we burned in kilns.

4419. Did you take up the floors and burn them?—Yes, we took up the floors and burned them in kilns.

4420. Did you do this only to the houses where plague had occurred, or did you do it to the whole village?—Only to the houses where plague had occurred.

4421. These three people who were attacked in outlying parts of the village, had they run away from the block which was first infected?—No, they were living in their own houses.

4422. Had they come to see sick people?—They were relatives of the sick, and visited them.

4423. I will go on now to the next village. You have had three villages infected, Chipagiri, Molagavelli, Holagundi?—Yes.

4424. I think Chipagiri is six miles from Guntakal. How many miles is Molagavelli from Chipagiri?—Ten.

4425. How was Molagavelli infected, do you know?—From Guntakal, we believe.

4426. Was that by Guntakal people going to Molagavelli or Molagavelli people going to Guntakal?—Molagavelli is on the Madras line, the second station from Guntakal; and we believe that it came in from Guntakal by rail.

4427. Was that by the Guntakal people running away from Guntakal, or by the Molagavelli people going to Guntakal and coming back again?—I can hardly say.

4428. How did you learn that Molagavelli was infected?—By a telegram from the Tahsildar, the chief native official in the district there.

4429. Did you go there then?—Dr. Evans went there. He is in the Indian Medical Service.

4430. You did not go there personally?—I went there after he went.

4431. How many days after?—I went a week after exactly.

4432. When you went had the people been all turned out into camp?—Some of them had. A great many of them had gone away, more than half the village.

4433. A little less than half the village was left in the village houses?—Most of them were out in camp, or in the fields. Some of the houses were deserted.

4434. Were any left in the village site?—In a few isolated places. The better class of people stayed in the villages: the labourers and cultivators deserted it.

4435. What had happened by the time you got there? Do you remember whether many cases had occurred?—At the time I was there, there were two cases. One was a Brahman beggar from the Hyderabad State. He was ill on a door-step, and taken to camp and died the next morning. He had well-marked buboes. The other case was that of a Toti woman, a low caste pariah woman, employed by the Ambulance staff in clearing away the excreta of patients. She had not been inoculated, and she died of plague. Since then there have been several cases, ten in all from the beginning. Cases are reported every day as dying in the fields.

4436. Did those ten cases occur within the village walls?—They came under the personal observation of myself or Dr. Evans.

4437. As regards the cases of people out in the fields you do not know how many are occurring?—We get reports, but the accounts are not authentic.

4438. Are you able to keep proper control over the people in the fields, and see that the healthy do not communicate with the sick?—We cannot do it.

4439. Do you use any mounted policemen to ride round the little settlements?—We have not any mounted police. The horses' legs would get broken in the soil. There are so many holes in the soil that they could not ride over it.

4440. So that the partial evacuation that has taken place has not been followed up by taking out such sick cases as may occur amongst the evacuated people and isolating them?—No.

4441. Has anything been done to prevent the evacuated people from visiting the infected village site?—Only the police guard over the houses that have been infected; but it is quite inefficient.

4442. There is not a guard over the whole village site?—There is a guard over the roadway, but they do not prevent people passing in and out. They are kept from entering infected houses, but not houses of their own which they have deserted and which are not infected. The infected houses are kept shut up. They are immediately disinfected after the removal of the people.

4443. Is there no system of hut to hut visitation of those people who are living out in huts in the fields?—It is being done now by Hospital Assistants.

4444. If plague people are found in these huts in the fields are they removed to a hospital?—I do not know. I have not been out recently.

4445. How about rats in the village of Molagavelli; have they been found there?—We found no rats.

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4446. Do you know how plague was carried about between the different houses in Molagavelli, whether it was apparently carried by human beings or by non-human agency?—By human agency, as far as we can discover.

4447. This third village Holagundi is not anywhere near Guntakal, is it?—It is on the other side of the district, near the river, on the border of the Bellary district and the Nizam's Dominions.

4448. Is there any infected area on that frontier?—On the Hubli side.

4449. I think you have only had one case there, and that an imported one?—Yes.

4450. And you knew of it by the man having a passport?—He was stopped at the frontier Inspection Station.

4451. He never got into the village?—No.

4452. He was kept in camp?—Yes.

4453. So that the village never got infected?—Not at all. It is some days since a case occurred, and they have had no more: it was on the 25th of November.

4454. The Molagavelli people are chiefly still out in their camp?—Yes.

4455. What is being done to disinfect their houses?—The Ambulance Staff are disinfecting houses, and recently 100 sepoys have been sent to help in the work.

4456. Have you had any opportunity of testing whether disinfection is effective? Do you find that people go back to disinfected houses, and develop plague?—We have had no instance so far.

4457. Have you any facts to give us with regard to the length of the period in which plague develops after exposure to infection?—As far as I have observed it is between four or five and ten days after exposure.

4458. In your opinion what are the most effective methods of combating plague in a village which is attacked?—The only effective method as far as I have seen at work at present, is segregating all the people who have been in contact with plague, and getting all the plague cases or fever cases out into a hospital, and then thoroughly disinfecting the houses, as thoroughly as we can without burning them.

4459. Do you find that that stops the spread of plague in a town, or that it merely reduces the number of cases?—It stopped it in Chipagiri finally.

4460. (*Prof. Wright.*)—Have you seen various forms of plague, pneumonic plague?—Yes; I have seen pneumonic and bubonic plague.

4461. What proportion of cases turn out to be pneumonic plague in your experience, is it common?—It is very uncommon.

4462. Have you any information of the percentage?—I should say certainly not more than four or five per cent.

4463. Have you seen any other types of plague but those two forms: have you seen the septicæmic form?—In a few cases, where the people have been 24 hours ill and died without any buboes.

4464. Have you any reason for supposing it is the choleraic form?—I have not seen any choleraic symptoms.

4465. Have you any facts to bring forward as to the treatment of plague.?—Treatment seems to be entirely useless.

4466. Have you any facts to show the efficacy, or otherwise of Haffkine's inoculations?—I have seen no case of plague occurring after inoculation.

4467. Have you had wide experience with regard to that?—I have inoculated about 1,500 people.

4468. (*Dr. Ruffer.*)—Were the 1,500 inoculated people in infected districts?—The great majority.

4469. In what places did you inoculate?—There were about 600 inoculations in Chipagiri. Plague was raging at the time. We inoculated nearly 200 at Molagavalli, and in Bellary about 300.

4470. (*Prof. Wright.*)—And you have seen no cases of plague afterwards?—No.

4471. Under what circumstances have you done these inoculations: have you been able to control the results?—In a great measure I have.

4472. Tell us something about these cases: are these in the villages you spoke of?—Yes. I inoculated 160 sepoys and they were under observation every day for a month afterwards. One man developed pneumonia: I did not consider it plague; there was no bubo. The man, however, was returned, when he got to Guntakal, by Dr. Robertson as having plague. The man recovered, and the sputum was sent to M. Haffkine, but M. Haffkine found no plague bacilli in it.

4473. Where were these sepoys, in a very infected area?—They had been at disinfection work, disinfecting houses; but this particular sepoy had not been near any case of plague, or doing disinfecting work for at least fourteen days before he was taken ill.

4474. Have you no more striking instances than that?—That is the most striking instance of a man recovering, that is, if he had plague.

4475. Have you anything to say with regard to protection afforded by inoculation?—I have had no other evidence beyond the fact that the people inoculated have remained free from plague.

4476. Do you find the people willing to be inoculated?—No; unless there have been many deaths from plague and they become panic-striken.

4477. (*Dr. Ruffer.*)—You told us of a man who had been stopped in the road frontier inspection at Holagundi: was that a case of pneumonic or bubonic plague?—Bubonic plague.

4478. Have you ever seen a case of pneumonic or septicæmic plague stopped at a Railway station?—I have not.

4479. You said you had some evidence showing the length of the incubation period, but you have not given us that evidence: have you any specific facts bearing upon it?—I have not got the dates with me.

4480. It is such an important thing that I should like to have it added to the evidence?—Certainly.

4481. (*The President.*)—Kindly give a narrative of each case, the dates, the mode of infection, and the time of incubation?—Yes. The first case was that of a little girl who was found suffering from cervical enlargements. She died the second day after the symptoms were seen. Her father nursed her from the time of her becoming ill: he took plague after she died, and he died the following day,—four days in all. I regard that as a case outside five days of incubation.

4482. (*Prof. Wright.*)—With regard to that case, had the father been in contact with the same source of infection as the little girl?—He brought it to the little girl. He had been to Guntakal the day before. The girl, who was about 12 years of age, was taken ill the following day, and died the day afterwards. He nursed her through the whole of the plague. He undoubtedly brought the infection to the house and gave it to her. She died, and he died afterwards.

4483. He brought it, and she got it the next day?—Yes.

4484. That is twenty-four hours?—That must be twenty-four hours; and she died four days afterwards.

4485. Was there no other source of infection: could she not have got it in the village except through him?—No; one was not allowed out.

4486 (*The President.*)—Might not the father have come in contact with plague on any other occasion but this one?—It is possible.

4487. (*Dr. Ruffer.*)—Have you any other cases?—I cannot recall any beyond those two cases. The people were so indefinite: they would not give any history of their visiting any infected people.

(Witness withdrew.)

MAJOR H. M. HAKIM, I.M.S., called and examined.

Major H. M. Hakim.

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4488. (*The President.*)—I believe you are medical officer on plague duty at Tungabhadra?—Yes.

4489. You are a Licentiate of the Royal College of Surgeons, Edinburgh?—Yes.

4490. Have you had some experience in railway inspection stations?—Yes. The first railway inspection station was opened in Guntakal in February 1898, when I was District Medical Officer of Anantapur. It was started under an Assistant Surgeon, and I had the supervision of it.

4491. What is the system followed at this station?—All

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the people that were coming from Bombay were inspected medically, but we had no system of segregation or detention.

4492. At this time you merely examined them?—Yes.

4493. Your arrangements were not then complete?—No.

4494. With what object did you examine the travellers?—To find out if there were any suspicious cases of plague travelling. They might have been segregated in any place. We would have got the loan of the Cholera Hospital from the Railway authorities.

4495. You had available resources?—Yes.

4496. After that you developed your arrangements further and obtained the services of a commissioned officer?—On the 12th of February.

4497. What system had you?—The same system. A plague camp was built and then the same system was followed until September, when we found a case of plague. The case died. The man came from Wadi after a segregation of ten days there. He was a horse-keeper. He came from Poona and from Poona he went to Sholapur, both of which places were infected. Then he came with a pass to say that he had been detained at Wadi owing to fever. He developed symptoms of plague, and died the day after at Guntakal.

4498. In your hospital?—In the Plague Hospital.

4499. That is one case?—Yes.

4500. How many people have you detained altogether?—Guntakal?—Thirty-two.

4501. How many of those exhibited symptoms of plague?—Only one.

4502. How many people have you examined altogether?—69,050.

4503. Out of all these you only detected one case?—Yes.

4504. Where was the next place you went to?—The camp was moved off to Tungabhadra.

4505. How does this place stand relatively to the former?—It is at the extreme end of the Madras Presidency, 5 miles nearer Bombay than Guntakal. It is on the river Tungabhadra, which divides the Nizam's territory from the Madras Presidency.

4506. What was the system you followed there?—The system was a little more elaborate, because we were supplied with more sheds for segregation and with disinfectants and steam disinfecting apparatus.

4507. And also, I suppose, with a segregation camp?—A health camp, and a plague camp, separate.

4508. How many have you examined there?—Since the 22nd of April, we have examined 31,272.

4509. Up to what date?—Up to the 10th of December.

4510. How many have you detained out of those?—For 24 hours, 4,317 and for ten days, 1,472.

4511. First tell me what were the cases you detained for 24 hours; who were they?—They came from infected areas. But they were well-to-do people and people who could be depended upon for their history, and who could be traced at their place of destination.

4512. You detained them, and disinfected their bodies?—Yes, and their baggage.

4513. How did you do that?—They were first marched to the detention shed, where their clothing is taken away from them, and everything in their baggage, and they are given a piece of Government clothing. Then they are marched down to the bathing platform, and they are individually made to squat down. We have two tubs. One contains a solution of phenyle, 1 in 100, and the other contains water. They are given a good scrubbing with phenyle solution, and afterwards washed in hot water. Then they are allowed to go outside, to this shed, and they are given a change of Government clothing again. All their clothing is taken to the disinfecting engine and disinfected for 30 minutes under a steam pressure of 30 lbs.

4514. Why did you detain some people for 10 days?—They were pilgrims coming by road from unknown areas. They could not be depended upon as to where they said they came from, and the place they were going to. They were very dirty.

4515. But they were in good health?—Yes, they were in good health. They were detained and disinfected. They were kept for ten days, and then allowed to go. Some were pilgrims returning from Mecca. Some came from infected areas and where plague was still existing,—nurses who had come from plague nursing, and people who had been from the Madras Presidency to Bombay to make purchases.

4516. How many plague cases did you discover among them?—None.

4517. I understand that you have had some experience with regard to villages?—I have been District Medical Sanitary Officer of a district in which plague is now existing, Anantapur; I have been there five years.

4518. Have you any knowledge with regard to plague?—No, not in that district.

4519. Can you speak with regard to general sanitation?—Yes. As a rule the villages are very dirty.

4520. Has plague occurred in such a village to your knowledge?—It has occurred in Hindupur.

4521. How would those insanitary conditions affect the distribution of the plague?—Unless the people were taken out, and the village completely disinfected I do not think we should be able to get rid of the infection. I should like to mention that there was one case allowed to pass after 24 hours' detention, which developed plague, at Kodaikanal.

4522. Did it become a focus for further developement?—No, it was a single case, and was immediately treated.

4523. (*Dr. Ruffer.*)—In the disinfecting apparatus which you used, how did you ascertain the temperature inside?—I did not ascertain the temperature.

4524. You simply took the pressure?—That is all.

4525. I suppose the manometer must have been verified?—Verified at Madras. It was tested in the presence of the Sanitary Commissioner, and sent to us.

4526. Have you any idea what temperature a pressure of 30 lbs. per square inch corresponds to?—No. [Witness subsequently submitted a statement that 30 lbs. pressure theoretically gives a temperature of 250° though in practice, in the disinfecting apparatus in question, it gave a temperature of at least 236°].

4527. You do not know what temperature that would correspond to inside a mattress?—No.

(Witness withdrew.)

LIEUTENANT-COLONEL W. G. KING, I.M.S., recalled and further examined.

Lieutenant-Colonel W. G. King.

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4528. (*Mr. Hewett.*)—Could you tell us about the disinfector in use here: did you have it tested?—I had it tested before me.

4529. (*Prof. Wright.*)—What is the atmospheric pressure per square inch?—14·7 lbs., one atmosphere.

4530. So that 30 lbs. pressure would be two atmospheres?—Yes.

4531. (*Dr. Ruffer.*)—Could you tell us what temperature that corresponds to?—I satisfied myself on the fact that it was 212° Fahr. As far as I remember, it was more than that; 30 lbs. would give about 250° Fahr. Under 15 lbs. would be 212° Fahr. I now remember that in the trial, no self-registering thermometer was available. A non-registering thermometer was placed in a closely rolled bundle of the blankets. During the opening of the blankets, the column of mercury no doubt fell, before it could be read. Under these circumstances, nevertheless, a temperature of 236°Fahr. was ascertained.

4532. After how long?—That would depend upon what sort of machine you are dealing with. It would depend upon the extent of the absorption of heat at the sides.

4533. Supposing we took a mattress, and put a thermometer inside, how long would it take before the thermometer inside that mattress went up to 250° Fahr.?—I think from Professor Smith's experiments in London that 25 minutes is regarded as a fair average to take.

4534. Would that not depend upon the kind of steriliser you had?—Granting it was an efficient one, that is to say one which would displace air.

4535. And on the material you put in?—Yes.

4536. In the steriliser at the railway station, have you any valves to let out the air?—Yes.

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4537. How is the disinfection done?—An attempt is made to imitate the "Washington" machine as far as possible. The "Washington" machine has a double jacket. It has the internal lining warmed so as to prevent condensation. We have not got that, because it means expense, and these are all temporary things. Therefore we carefully let in steam at first so as to make certain of getting up the temperature at the sides. During the time that condensation occurs at the sides, water is let off at the lower valve. After the machine is properly warmed in that way, we put in the clothing, and then we attempt to get a vacuum with the object of driving the air out of the pores of the clothing. That is done by letting in the steam and letting it off rapidly.

4538. Letting in steam for how long?—It would be a matter of getting up the 30 lbs: the time necessary would differ with the type of boiler providing the steam and other factors. You watch the machine until it gets up to 30 lbs. pressure and as far as we can we drive the steam in after displacing the air in the material by letting it off rapidly. Finally the production of a vacuum is secured by rapid condensation by using cold water.

4539. If I understand you aright, you send up the temperature to 30 lbs. pressure, and then let the steam out?—Yes.

4540. What do you do afterwards?—Then let the steam back again, and then having let it out another time we allow condensation to occur by using cold water in a cylinder in communication with the interior of the disinfecting chamber. In the first process, we imitate the method of the "Washington" machine of using a jacket by heating the sides and thus preventing condensation; in the second and third, we attempt displacement of air in the clothing. Then there is a vacuum gauge. Having secured as big a vacuum as possible (I think it was 20 inches of mercury), the steam is let in finally, and it is kept at a steady pressure of 30 lbs. for half an hour. Lastly, the vacuum process is repeated, so as to secure full drying of the clothing. Half an hour is longer than really necessary, but as the clothing of the average native is not delicate material, the procedure is on the side of safety.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Mayo Hall, Bangalore.

FOURTEENTH DAY.

Friday, 16th December, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT,
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE,
DR. M. A. RUFFER.
MR. C. J. HALLIFAX (*Secretary*).

CAPTAIN B. H. F. LEUMANN recalled and further examined.

Captain B. H. F. Leumann.

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4541. (*The President.*)—We wish to ask you a few further questions?—Yes.

4542. (*Dr. Ruffer.*)—We want some further evidence on some points raised at your last examination. We have been told that you had some evidence as to the period of incubation of plague. I believe you have been a sufferer yourself from that disease; perhaps you will kindly give us some information as to how the disease progressed in you?—In my own case it was extremely slight. The incubation period was three days, almost exactly.

4543. Can you tell us your reason for supposing the incubation period to have been three days?—I inoculated myself at a *post-mortem* against the rib of a plague patient: I still have a small scar on my wrist where it was done.

4544. Could you show us the scar?—It is a very tiny little spot. I got a small bleb there. (The witness indicated the spot on his wrist.)

4545. It is like the mark of an old blister?—It was a blister.

4546. (*The President.*)—How big was the blister?—It was smaller than a three-penny piece. The blister came up on the fourth day, but I felt ill on the evening of the third day.

4547. (*Dr. Ruffer.*)—Did you simply scratch the epidermis, or did it bleed?—Not that I know of, but my hands were covered with blood from the *post-mortem*. I did not notice it until after the *post-mortem*, when I felt a little tingling when the perchloride got on it. When I washed my hands I noticed I had scratched myself. I immediately sucked it, and tried to suck out whatever was there. I took no notice of the thing at all, but three days afterwards I had slight fever. The symptom I noticed most was a sort of mental aberration. I hardly knew what I was doing.

4548. Could you tell us the exact date when you were inoculated?—It was on the 21st of December last year, nearly 5 o'clock in the afternoon.

4549. When did you notice the first symptoms?—On the 24th of December last year, at about 7 o'clock at night.

4550. What symptoms did you notice?—At first, nearly all day a feeling of malaise, which in the evening amounted to a sort of mental aberration. I could not play cards at the Club. I more or less staggered home. I was much annoyed with my servants and was going to whip a chokra (a little servant boy). As I raised my arm I felt a pain in my arm pit and put my hand there. I found a small painful lump there, a little bigger than an almond with the shell on; it increased to about the size of a small nut. It was bigger the next day, and two days afterwards, it reached its biggest size. It remained so for about three or four weeks. I could feel it every time I put my arm down. It did not suppurate. I only had fever about a day and a half. On the first day my temperature was only 99·4°; on the second evening it was 101°.

4551. What became of the bleb?—I pricked that.

4552. That came on the fourth day?—The fourth day after I scratched myself: the day after I had sickness. It came first of all as very tiny pin head, like a small herpes. It enlarged to the size of a three-penny bit. The fluid inside was clear. We pricked it, and inoculated it into an agar tube, but nothing grew from it.

4553. You had no lymphangitis spreading from the point?—Yes, I had several streaks right up my arm, and the cubital gland was very painful.

4554. You have no doubt that the case from which you inoculated yourself was one of plague?—I am certain the case I inoculated myself from was one of plague.

4555. You have no reason to suppose that the patient was suffering from some secondary infection?—No.

4556. I think you had been inoculated before?—Yes.

4557. When was the date of your first inoculation?—I have been inoculated three times. I have inoculated myself twice. I was inoculated first of all in Bombay

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with Yersin's serum. I forget the exact date. It was in March 1897. I was inoculated with Haffkine's lymph in July 1897. It was after the first inoculation with Haffkine's lymph that I got what I took to be a slight attack of plague.

4558. Six months afterwards?—Yes, six months afterwards.

4559. On the whole the symptoms were very slight?—Yes, very slight indeed; but my eyes were blood-shot and I had a tongue which is supposed to be typical of the disease.

4560. I think you have got some information with regard to another similar case?—I can mention two. The first was the case of Dr. Stricker, in Bombay.

4561. We have had that from another source?—He was a patient of mine.

4562. Then we had better have your account of it?—I cannot give you the exact details. That was an incubation period of three days also; and the bleb was the first thing noticed in that case. Plague bacilli were grown from the blister, which was touched with a very strong solution of perchloride of mercury: I do not know what strength, but something like 1 in 10. The blister was cut round and the whole thing swept away. He was delirious and brought into hospital, where he remained five days. His temperature never went beyond 101, and at that point it only lasted 24 hours.

4563. I think he had an enlarged gland in the axilla?—Yes.

4564. Did that suppurate?—No.

4565. Had he been inoculated?—No.

4566. How did he inoculate himself?—At a *post-mortem*. It was against a rib too. He inoculated himself on a Saturday afternoon, I think, and on Tuesday morning he got up feeling very seedy. He looked at himself and shouted out for Dr. Pfeiffer or somebody to come and look at him, and he said "I do not know what is the matter; I have a blister on my hand; I feel very ill". They looked at the blister, and looked at him, and they concluded that he had an attack of plague. They cut into the blister and inoculated an agar tube and grew bacilli from it.

4567. Then I think you had a second case?—Yes, the case of a compounder. He compounded medicine in my hospital at Hubli. The man is now here in Bangalore. He was bitten on the thumb by a delirious pneumonic plague patient whom he was trying to get back into bed. I will not be quite sure of the date, but 3½ or 4 days afterwards he complained of feeling ill. He had a rigor. He was sent to bed and I went to see him. By the look of the man I concluded it was rather suspicious, and I kept him under observation for 24 hours. During that time he developed a painful bubo under his right arm. He was in hospital for about seven days. His temperature never went above 102°. We have got his chart somewhere or other.

4568. He recovered, I believe?—Yes, he recovered.

4569. Had he been inoculated?—No, he had not.

4570. Have you made any observations on infection through the alimentary canal?—Although I have frequently seen the mesenteric glands enlarged, I have not yet seen a case in which they alone were enlarged, or in which I could find any definite local intestinal lesion proving that absorption had taken place in the alimentary canal. The most marked instances of congestion of the stomach with hæmorrhages and petechiæ and similar lesions of Peyer's patches and other intestinal glands that I have seen have been in those cases where I have been able to trace other points of inoculation, and to a certain extent watch the spread of the disease in the body before death. I could not at all reasonably suppose in the cases in which I found congestion that that was the site of attack or invasion, as marked other lesions, *e.g.* femoro-iliac buboes, etc. were present, and far more conspicuous, as a primary lesion: in one of these cases, indeed, there was also a well marked blister on the dorsum of the left foot marking the site of invasion. On the other hand this is quite a likely method of invasion, and should not be forgotten as a possible one.

4571. There is another point I want to ask you about. I am not sure whether I am right, but I believe you have some facts bearing on plague in families in which certain members have been inoculated, and others have not?—Yes.

4572. Could you give us the details of those cases?—I cannot, because there are 77 cases. The papers are all before the Government now and I have not got any copies. They were all put forward in my Hubli Inoculation Report. I requested that the report might be printed. I take it that those cases will be printed with the report.* I have applied to get it.

4573. We can get these details from the report I suppose?—These cases are rather interesting because the names of the people are given, the number of the house, the ages, the date of inoculation and the date of attack, both amongst inoculated and among uninoculated. I have given both equally fairly.

4574. Have you any evidence as to the presence of plague bacillus on or in the floor of infected houses?—The way I looked for plague bacilli in scrapings from "infected" houses was as follows:—In 25 instances (5 in Bombay, during September and October 1897, and the remaining 20 in Sholapur, during November and December 1897, and the early part of January 1898) I collected surface scrapings from near where I found a plague corpse lying, into sterilized glass-stoppered bottles. I did not, unfortunately, keep the addresses of the houses, but simply numbered my bottles and noted the results in my note-book under headings 1, 2, 3, etc. It was while I was in Sholapur that I found plague bacilli in such scrapings, and I have little doubt that the patient had spat them on the ground before he died (primary plague pneumonia in two instances), both Shimpis (*i. e.*, tailors, by caste), and the third had also a small bubo in the right axilla. After examining these colonies that grew in my dishes and which looked like plague, or streptococci, under the microscope, and finding bacilli like pest bacilli in these three instances, I inoculated a rat in each case. The first rat died in about 48 hours (between midnight and 6 A. M., so I can't be quite sure); the second died in 64 hours, and the third rat died in about 60 to 66 hours. In all three rats I found pest bacilli in the spleen and heart's blood, and all three shewed the usual signs of local re-action—plastic lymph, etc.—at the site of inoculation, which was under the skin of its back near the tail. That's all I can tell you about the matter.

4575. Will you put in the notes you made on a case of acute plague septicæmia, with *post-mortem* examination?—Yes.†

4576. Was the urine examined for the purpose of ascertaining whether bacilli were present in it?—The urine and fæces were not examined.

4577. (*The President.*)—I think you can show us some labels from plague prophylactic bottles?—Yes; I produce five:—

(1) The Plague Prophylactic.

No. of Brew 4180. Date of bottling________

Bottle contains 25 C.C.

Dose for adult man 3¾ C.C.
(*i.e.*, 1½ times the standard dose.)

Bombay Plague Research Laboratory.

(2) The Plague Prophylactic.

No. of Brew 4183. Date of bottling ________

Bottle contains 35 C.C.

Dose for adult man 5 C.C.
(*i.e.*, 2 times the standard dose.)

Bombay Plague Research Laboratory.

(3) The Plague Prophylactic.

No. of Brew 4469. Date of bottling________

Bottle contains 15 C.C.

Dose for adult man 6¼ C.C.
(*i.e.*, 2½ times the standard do

Bombay Plague Research Laboratory.

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* See Appendix No. XV in the Volume.
† See Appendix No. XVII in this Volume.

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(4) The Plague Prophylactic.

No. of Brew 4624. Date of bottling ——

Bottle contains 30 C.C.

Dose for adult man 7½ C.C.

(*i.e.*, 3 times the standard dose.)

Bombay Plague Research Laboratory.

(5) The Plague Prophylactic.

No. of Brew 5165. Date of bottling——

Bottle contains 70 C.C.

Dose for adult man 10 C.C.
(*i.e.*, 4 times the standard dose.)

Bombay Plague Research Laboratory.

(Witness withdrew.)

LIEUTENANT-COLONEL H. P. ESMOND WHITE, I.M.S., called and examined.

Lieutenant-Colonel H. P. Esmond White.

16th Dec. 1898.

4578. (*The President.*)—I believe you are in medical charge of the 1st Pioneers, and have some information to give to the Commission with regard to inoculation?—Yes. I am in medical charge of the 1st Pioneers. I have not got any list of cases, but I can give the numbers that have been done. When inoculation was first commenced in the Pioneers on the 17th of October, the strength of the Regiment was then 821, 72 of whom were absent from head-quarters. There were 47 camp followers. Eight hundred and one men have been inoculated and 639 men have been re-inoculated.

4579. You say that 72 were absent?—Yes, 72 were absent on recruiting and other purposes.

4580. That leaves 749?—Yes, that was the strength of the Regiment.

4581. Forty-seven were camp followers?—Yes.

4582. That makes a total of 796, does it not, counting camp followers: how do you make it 801 inoculated?—That was the number given to me from the returns of the number of inoculations, 801.

4583. Probably some of the 72 had returned?—Yes, all returned. Up to the time of the first inoculation on the 17th of October no cases of plague occurred. No plague occurred in the Regiment up to the time of the first inoculation.

4584. Subsequently?—After inoculation four cases occurred, three amongst the men and one a pension boy. The pension boy is not included in the strength. This boy did not live in the lines of the Regiment; he lived in a place called Black Pully.

4585. (*Dr. Ruffer.*) Had the boy been inoculated?—Yes, and he had contracted plague. He was inoculated on the 4th of November, and he was attacked on the 9th. He was sent to the plague camp. He has recovered.

4586. When had the three other cases been inoculated?—Private Murugan was inoculated on the 17th of October and re-inoculated on the 24th of October. He was attacked with plague on the 27th of November and died on the 1st of December.

4587. What about the second one?—The second one was Private Lutchmiah. He was inoculated on the 17th of October 1898, and re-inoculated on the 24th of November 1898, and he died on the 13th of December. These men all died away from me. As soon as they were found to have plague, they were removed to the Military camp.

4588. There is no doubt of their having plague?—I considered they had plague, and the officer in charge told me they were cases of plague.

4589. There is another case I think?—There is the case of a man who was not inoculated. He died of pneumonic plague. Private No. 1918, Mahomed Khan, 1st Madras Pioneers, age 22, was first seen on October 25th when he had fever. As it continued, he was admitted into the hospital. On the 28th pneumonia in both lungs was detected, pulse 120, respiration 56, temperature in axilla 102. He continued very much in that condition until the morning of November 2nd when he died suddenly apparently from heart failure. There was nothing to show that this was a case of plague, but as a precaution he was isolated and his house disinfected. His sputum was sent for bacteriological examination and was found to contain (loaded) plague bacilli. All the necessary precautions were taken, and the disease did not spread. This case may have been due to infection as he lived with a woman outside the Regimental lines.

4590. You have no doubt that it was a case of plague?—I sent his sputum to Colonel Benson, Darbar Physician here, and he wired back to say that the man's sputum was full of plague bacilli. That was the only reason it could be returned actually as a case of plague. I thought at first it was a case of ordinary double pneumonia.

4591. He was uninoculated?—He was uninoculated.

4592. How many uninoculated were there?—I could not tell you. At that time we had only just begun inoculating.

4593. Had you any deaths from plague among them before the inoculation?—No, we have only had these four deaths from plague. The regiment is quartered in an open place at the north of the city. They are very good lines. It is a good open place, and well drained, but it is very feverish. We suffer a good deal from fever.

4594. Are they in their usual quarters, or have they been removed to another place?—They are in their usual quarters. They have been there, I think, a year and a half. About two years ago they were in some other lines. Those lines were abandoned, and now we have new lines, which except for fever are very healthy.

4595. (*The President.*)—Can you account for the occurrence of these cases?—Only the first,—the uninoculated man. Possibly he got it through contagion, because he had a woman living with him. If he was a married man, his family were not here. He was living in bachelor quarters, but he had a woman out in the village. It may have been through her that he got it. That was the only reason we could account for it.

4596. Was each case which occurred in the lines removed and isolated?—They were brought to the hospital, which is nearly two miles from the lines. First, they were put into a hut separately, and then they were removed to the plague camp.

4597. Were the usual methods for disinfection employed?—Yes; the roofs were taken off, and the houses disinfected.

5498. (*Dr. Ruffer.*)—Who did these inoculations?—I did them.

4599. What dose did you use?—I used the doses marked on the bottles, except in the case of boys, in which case they were reduced according to the orders we had received, taking 2½ c.c. as the standard dose.

4600. Did you have any abscesses?—I had one abscess. There is a man now with an abscess, not a man that I did. One was done in the city. Three men came with abscesses.

4601. Did you have any dangerous symptoms after inoculation?—One boy that I inoculated died within three days.

4602. Of what?—He got fever, which never left him and he died.

4603. Do you know when fever first set in after inoculation?—No, not with regard to him. There were two or three hundred people inoculated. They retired to the lines, and unless there was anything specially the matter with them, I would not see them. He would naturally have the ordinary fever.

4304. Have you any reason to believe that that boy died of plague?—I have no reason to believe it.

4605. You have reason to believe that he died of the inoculation?—If I was asked I should say he died from the fever, and the fever was probably brought on by inoculation. If I inoculated a man, and he is apparently well, and if he gets fever, and if the fever continues and he dies within three days, I should certainly be inclined to think that he died from the effects of it, unless there was anything to show that he died from plague. As a matter of fact in this boy's case I did not know anything about him until he was dead.

4606. After the people were inoculated they were allowed to move freely about the city?—They go to their houses.

4607. They can go about if they like?—They are not allowed to go into the town for several days after inoculation. During that time they are confined to their lines. Those are the Commandant's orders.

4608. Afterwards they are allowed to go into the town?—As soon as they are quite well again. I have here the papers that Lt.-Colonel Armstrong, I.M.S., put in. He is in charge of the Plague Hospital, and he has prepared some statistics.

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The statement is as follows:—

1. (*a*)	Total strength of troops	2,929
(*b*)	Total strength of followers	3,222
2. (*a*)	Average once-inoculated troops	1,333
(*b*)	Average once-inoculated followers	1,438
(*a*)	Average twice-inoculated troops	718
(*b*)	Average twice-inoculated followers	252
4. (*a*)	Average non-inoculated troops	1,596
(*b*)	Average non-inoculated followers	1,784

	Attacks.	Deaths.	Recoveries.
5. (*a*) 1. Among inoculated troops, number of	27	16	1
2. Among twice-inoculated troops, number of	...	...	...
3. Among non-inoculated troops, number of	8	7	1
(*b*) 1. Among once-inoculated families, number of	15	6	3
2. Among twice-inoculated families, number of	1	1	...
3. Among non-inoculated families, number of	6	4	2
Troops.			
6. (*a*) 1. Among inoculated, percentage of deaths and recovery to admission	...	59·25	3·70
2. Among non-inoculated, percentage of deaths and recovery to admission	...	87·50	12·50
Families.			
(*b*) 1. Among inoculated, percentage of death and recovery to admission	...	40	20·
2. Among twice-inoculated, percentage of death and recovery to admission	...	100	*Nil.*
3. Among non-inoculated, percentage of deaths and recovery to admission	...	66·67	33·33

7. Details of attacks and deaths with reference to age, duration of case, position of buboes for each class (*a*) and (*b*) and for once-inoculated, twice-inoculated and non-inoculated in each class:

	Age.	Attacks.	Deaths.	Duration of fatal cases.	
(*a*) *Troops* 1. Once-inoculated	15 to 24	10	5	In 1 day	3
	25 to 34	13	9	„ 2 days	2
	35 to 44	4	2	„ 3 „	5
				„ 4 „	2
		27	16	„ 5 „	1
				„ 6 „	1
				„ 7 „	2
					16
2. Twice-inoculated	*Nil.*				
3. Non-inoculated	15 to 24	3	3	In 1 day	2
	25 to 34	3	2	„ 2 days	2
	35 to 44	2	2	„ 3 „	2
				„ 4 „	1
		8	7		7

Position of buboes in the attacks

Inoculated.

Groin.	Axilla.	Neck.	Not recorded.	Without buboes.	Total.
21	1	1	...	4	=27

Non-inoculated.

Groin.	Axilla.	Neck.	Not recorded.	Without buboes.	Total.
5	1	...	2	...	=

Lieutenant-Colonel H. P. Esmond White.

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Position of buboes in deaths

	Groin.	Axilla.	Neck.	Not recorded.	Without buboes.	Total.
Inoculated.	11	...	1	...	1	
Non-inoculated.	4	1	...	2	...	

(*b*) ***Families***

	Age.	Attacks.	Deaths.
1. Once-inoculated	1 to 10	6	2
	11 „ 20	4	2
	21 „ 30	2	...
	31 „ 40	1	1
	41 „ 50	...	...
	51 „ 60	2	1
		15	6
2. Twice-inoculated	1 to 10	1	1
		1	1
3. Non-inoculated	1 to 10	2	2
	11 „ 20	1	1
	21 „ 30	...	...
	31 „ 40	1	...
	41 „ 50	2	1
		6	4

Duration of fatal cases.

1. Once-inoculated	In 1 day	3
	„ 2 days	1
	„ 6 „	1
	„ 18 „	1
		6
2. Twice-inoculated	In 2 days	1
		1
3. Non-inoculated	In 1 day	2
	„ 2 days	2
		4

Position of buboes in the attacks

	Groin.	Axilla.	Neck.	Not recorded.	Without buboes.	Total.
(1) Inoculated	6	3	3	...	3	=15
(2) Twice-inoculated	...	1	...	...	...	=1
(3) Non-inoculated	1	0	1	1	3	=6

Position of buboes in the deaths

	Groin.	Axilla.	Neck.	Not recorded.	Without buboes.	Total.
(1) Inoculated	2	2	...	...	2	=6
(2) Twice-inoculated	...	1	...	...	...	=1
(3) Non-inoculated	1	...	1	1	1	=4

4609. (*Prof. Wright.*)—In the case of this boy who died three days afterwards, did you see the body?—No. The Hospital Assistant examined it.

4610. Do you know whether he had any buboes?—I was told that he had none. When I went to the hospital, the Hospital Assistant told me that this boy had died. I asked him whether he had buboes, or whether anything had developed upon him, and he said "No".

4611. (*The President.*)—Who was in medical charge of the hospital in which this boy was treated after he left you?—He was never in the hospital. He was inoculated in the lines. The hospital is nearly two miles away from the lines.

4612. He died in the lines?—Yes, he died in the lines.

4613. When he became ill who attended him?—I do not know if he made any report of his illness. I knew nothing of him from the time he was first of all inoculated. I never heard anything about him until I heard he was dead on the third day.

4614. Do you know who attended him?—I believe the Hospital Assistant saw him.

4615. Was there a *post-mortem*?—No, there are rarely *post-mortems* amongst the native troops.

(Witness withdrew.)

LIEUTENANT R. W. CLEMENTS, R. A. M. C., called and examined.

Lieutenant R. W. Clements.

16th Dec. 1898.

4616. (*The President.*)—I believe you are in medical charge of troops in Bangalore?—Yes.

4617. What troops?—The 4th Hussars.

4618. You have had some experience of inoculation?—Yes. I have done a great many inoculations amongst the troops. I have inoculated most of the followers of the 4th Hussars, Field Batteries, and the Horse Artillery.

4619. Take the followers of the 4th Hussars first. What was the total weekly strength of the camp followers before inoculation?—That I could not ascertain.

4620. Why not?—When I went to inoculate the followers, the first thing I did was to get as soon as possible the strength of the lines. I was told by the Quarter-Master of the regiment that the strength, as near as he could guess, would be about 800. I did 1,068 primary inoculations, so that he must have been 268 out in his total strength. Having done 1,068, there were still men left uninoculated. I do not know how many remained. I should say a very few—possibly not over 50.

4621. How many cases had there been among these followers before the inoculations began?—The first case of plague occurred on the 25th of October. There were three cases on this date uninoculated.

4622. On what dates were the inoculations begun?—I commenced inoculating the next day, the 26th.

4623. On the 25th you had three cases?—Yes, I had three cases on the 25th.

4624. In the same house, or in different houses?—There were no two cases in the same house, except in one instance.

4625. How many deaths out of those three cases?—All three died.

4626. You began inoculating on the 26th October, when did you finish the inoculations?—I finished the inoculations about four or five days afterwards.

4627. Did you re-inoculate any of these people?—I re-inoculated 618.

4628. When?—On the 19th of November.

4629. You have a table you could put in showing the total number of cases of plague, and the total number of deaths?—Yes. I wish to put in the following tables:—

Lieutenant R. W. Clements.

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Plague Return up to 20th December 1898 of Followers of 4th "Queen's Own" Hussars.

DATE.	TOTAL NO. OF CASES.			TOTAL DEATHS IN THE LINES.			TOTAL TRANSFERS TO CIVIL PLAGUE HOSPITAL.					INOCULATED.			NOT INOCULATED.			REMARKS.
										Result.								
	Male.	Female.	Total.	Male.	Female.	Total.	Male.	Female.	Total.	Recovered.	Died.	Male.	Female.	Total.	Male.	Female.	Total.	
5th October 1898	2	1	3	2	1	3	...	...	...	...	...	...	...	...	2	1	3	3 cases {Male 2. Female 1.
26th " "	5	2	7	4	1	5	1	1	2	...	...	...	...	...	5	2	7	4 cases {Male 3. Female 1.
27th " "	5	2	7	4	1	5	1	1	2	...	...	...	...	...	5	2	7	No cases.
28th " "	6	3	9	4	2	6	2	1	3	...	...	1	1	2	5	2	7	2 cases {Male 1. Female 1.
29th " "	6	3	9	4	2	6	2	1	3	...	...	1	1	2	5	2	7	No cases.
30th " "	6	3	9	4	2	6	2	1	3	...	...	1	1	2	5	2	7	Do.
31st " "	6	3	9	4	2	6	2	1	3	...	...	1	1	2	5	2	7	Do.
1st November "	8	3	11	5	2	7	3	1	4	...	...	2	1	3	6	2	8	2 cases, male.
2nd " "	8	5	13	5	4	9	3	1	4	...	...	2	3	5	6	2	8	2 cases, female.
3rd " "	8	8	16	5	7	12	3	1	4	...	...	2	5	7	6	3	9	3 cases, female.
4th " "	9	10	19	6	8	14	3	2	5	...	...	2	7	9	7	3	10	3 cases {Male 1. Femal 2.
5th " "	11	10	21	8	8	16	3	2	5	...	5	4	7	11	7	3	10	2 cases, male.
6th " "	11	12	23	8	10	18	3	2	5	...	5	4	7	11	7	5	12	2 cases, female.
7th " "	11	14	25	8	12	20	3	2	5	...	5	4	7	11	7	7	14	2 cases, female.
8th " "	12	14	26	9	12	21	3	2	5	...	5	5	7	12	7	7	14	1 case, male.
9th " "	15	15	30	12	13	25	3	2	5	..	5	5	7	12	10	8	18	4 cases {Male 3. Female 1.
10th " "	15	18	33	12	15	27	3	3	6	...	5	5	7	12	10	11	21	3 cases, female.
11th " "	16	18	34	13	15	28	3	3	6	...	5	6	7	13	10	11	21	1 case, male.
12th " "	16	18	34	13	15	28	3	3	6	...	5	6	7	13	10	11	21	No cases.
13th " "	17	19	36	14	16	30	3	3	6	...	5	6	7	13	11	12	23	2 cases {Male 1. Female 1.
14th " "	17	20	37	14	17	31	3	3	6	...	5	6	7	13	11	13	24	1 case, female.
15th " "	21	21	42	17	17	34	4	4	8	1	7	6	8	14	15	13	28	5 cases {Male 4. Female 1.
16th " "	21	21	42	17	17	34	4	4	8	1	7	6	8	14	15	13	28	No cases.
17th " "	23	22	45	18	18	36	5	4	9	1	7	7	8	15	16	14	30	3 cases: {Male 2. Female 1.
18th " "	23	22	45	18	18	36	5	4	9	1	7	7	8	15	16	14	30	No cases: Followers removed into Camp.
19th " "	23	22	45	18	18	36	5	4	9	1	7	7	8	15	16	14	30	No cases.
20th " "	23	22	45	18	18	36	5	4	9	1	7	7	8	15	16	14	30	Do.
21st " "	23	22	45	18	18	36	5	4	9	1	7	7	8	15	16	14	30	Do.
22nd " "	23	22	45	18	18	36	5	4	9	1	7	7	8	15	16	14	30	Do.
23rd " "	23	22	45	18	18	36	5	4	9	2	7	7	8	15	16	14	30	Do.
24th " "	23	22	45	18	18	36	5	4	9	2	7	7	8	15	16	14	30	Do.
25th " "	23	22	45	18	18	36	5	4	9	2	7	7	8	15	16	14	30	Do.
26th " "	23	22	45	18	18	36	5	4	9	2	7	7	8	15	16	14	30	Do.
27th " "	25	22	47	18	18	36	7	4	11	2	7	7	8	15	18	14	32	2 cases, syces of officers.* Not attacked in Camp. Sent to Civil Plague Hospital.
28th " "	25	22	47	18	18	36	7	4	11	2	7	7	8	15	18	14	32	No cases.
29th " "	25	22	47	18	18	36	7	4	11	2	7	7	8	15	18	14	32	Do.
30th " "	25	22	47	18	18	36	7	4	11	2	7	7	8	15	18	14	32	Do.
1st to 20th December 1898.	25	22	47	18	18	36	7	4	11	2	7	7	8	15	18	14	32	Do.

* The two syces returned cured of plague on 15th December 1898.

Lieutenant R. W. Clements.

16th Dec. 1898.

Plague Return up to 20th December 1898 of Followers of 25th Field Battery, R. A.

Date.	Total No. of Cases.			Total Deaths in the Lines.			Total Transfers to Civil Plague Hospital.					Inoculated.			Not Inoculated.			Remarks.
										Result.								
	Male.	Female.	Total.	Male.	Female.	Total.	Male.	Female.	Total.	Recovered.	Died.	Male.	Female.	Total.	Male.	Female.	Total.	
1st November 1898	1	...	1	1	...	1	...	...	...	...	...	1	...	1	...	...	...	1 case, male, died, inoculated 27th November 1898.
2nd " "	1	...	1	1	...	1	...	...	...	...	...	1	...	1	...	...	...	No cases up to 12th November 1898.
12th " "	1	1	2	1	1	2	...	...	...	...	...	1	1	2	...	...	...	1 case, female, died, inoculated 1st November 1898.
13th " "	1	1	2	1	1	2	...	...	...	...	...	1	1	2	...	...	...	No cases up to 16th November 1898.
16th " "	2	1	3	2	1	3	...	...	...	...	...	2	1	3	...	...	...	1 case, male, died, inoculated 9th November 1898.
17th " "	2	1	3	2	1	3	...	...	...	...	...	2	1	3	...	...	...	No cases up to 21st November 1898.
21st " "	3	1	4	3	1	4	...	...	...	...	...	3	1	4	...	...	...	1 case, male, died, inoculated 19th November 1898.
22nd " "	3	1	4	3	1	4	...	...	...	...	...	3	1	4	...	...	...	No cases.
23rd " "	4	1	5	4	1	5	...	...	...	...	...	3	1	4	1	...	1	1 case, male, died, not inoculated.
24th " "	4	1	5	4	1	5	...	...	...	...	...	3	1	4	1	...	1	No cases.
25th " "	4	2	6	4	2	6	...	...	...	...	...	3	1	4	1	1	2	1 case, female, died, not inoculated.
26th " "	4	2	6	4	2	6	...	...	...	...	...	3	1	4	1	1	2	No cases up to 29th November 1898.
29th " "	4	3	7	4	3	7	...	...	...	...	...	3	2	5	1	1	2	1 case, female, died, inoculated 9th November 1898.
30th " "	4	3	7	4	3	7	...	...	...	...	...	3	2	5	1	1	2	No cases.
1st December "	4	4	8	4	4	8	...	...	...	...	...	3	3	6	1	1	2	1 case, female, died, inoculated 3rd November 1898.
2nd " "	4	4	8	4	4	8	...	...	...	...	...	3	3	6	1	1	2	No cases up to 4th December 1898.
4th " "	5	5	10	5	5	10	...	...	...	...	...	4	4	8	1	1	2	2 cases, male and female, died; male inoculated 27th October 1898, and female 3rd November 1898.
5th " "	6	7	13	5	7	12	1	...	1	...	...	5	5	10	1	2	3	3 cases, 1 male and 2 females; male sent to Civil Plague Hospital, inoculated 9th November 1898; females 2, died; inoculated 27th November 1898.
6th " "	6		13	5	7	12	1	...	1	...	...	5	5	10	1	2	3	No cases.
7th " "	7		15	6	8	14	1	...	1	...	...	5	6	11	2	2	4	2 cases, male and female, died; male not inoculated, female inoculated 27th November 1898.
8th " "	7	9	16	6	9	15	1	...	1	...	1	5	6	11	2	3	5	1 case, female, not inoculated, died.
9th " "	8	9	17	7	9	16	1	...	1	...	1	5	6	11	3	3	6	1 case male, died, not inoculated.
10th " "	9	9	18	8	9	17	1	...	1	...	1	6	6	12	3	3	6	1 case, male, inoculated 1st November 1898, died; followers removed into camp.
11th " "	9	9	18	8	9	17	1	...	1	...	1	6	6	12	3	3	6	No cases since 10th.
20th " "	9	9	18	8	9	17	1	...	1	...	1	6	6	12	3	3	6	No cases since 10th.

Lieutenant R. W. Clements.

16th Dec. 1898.

Plague Return up to 20th December 1898 of Followers of 21st Field Battery, Royal Horse Artillery.

DATE.	TOTAL NO. OF CASES.			TOTAL NO. OF DEATHS IN THE LINES.			TOTAL TRANSFERS TO CIVIL PLAGUE HOSPITAL.					INOCULATED.			NOT INOCULATED.			REMARKS.
										Result.								
	Male.	Female.	Total.	Male.	Female.	Total.	Male.	Female.	Total.	Recovered.	Died.	Male.	Female.	Total.	Male.	Female.	Total.	
13th November 1898	1	...	1	1	...	1	...	...	...	...	...	...	...	...	1	...	1	1 case, male, died, not inoculated.
14th " "	2	1	3	2	1	3	...	...	...	...	...	...	1	1	2	...	2	2 cases, male and female died; female inoculated 1st November 1898, male not inoculated.
15th " "	2	1	3	2	1	3	...	...	...	...	...	...	1	1	2	...	2	No cases up to 18th November 1898.
18th " "	3	1	4	3	1	4	...	...	...	...	...	1	1	2	2	...	2	1 case, male, died, inoculated 3rd November 1898.
19th " "	3	2	5	3	2	5	...	...	...	...	...	1	2	3	2	...	2	1 case, female, died, inoculated 3rd November 1898.
20th " "	3	2	5	3	2	5	...	...	...	...	...	1	2	3	2	...	2	No cases up to 22nd November 1898.
22nd " "	3	3	6	3	3	6	..	...	...	...	...	1	2	3	2	1	3	1 case, female, died, not inoculated.
23rd " "	3	3	6	3	3	6	...	...	...	...	...	1	2	3	2	1	3	No cases up to 27th November 1898.
27th " "	3	4	7	3	4	7	...	...	...	...	...	1	3	4	2	1	3	1 case, female, died, inoculated, 1st November 1898.
28th " "	3	4	7	3	4	7	...	...	...	...	...	1	3	4	2	1	3	No cases up to 8th December 1898.
8th December "	3	5	8	3	5	8	...	...	...	...	...	1	3	4	2	2	4	1 case, female, died, not inoculated.
9th " "	4	5	9	4	5	9	...	...	...	...	...	2	3	5	2	2	4	1 case, male, died, inoculated 27th October 1898.
10th " "	4	5	9	4	5	9	...	...	...	...	...	2	3	5	2	2	4	No cases.
11th " "	6	5	11	4	5	9	2	...	2	...	...	4	3	7	2	2	4	2 cases, males; sent to Civil Plague Hospital; inoculated 27th October and 3rd November 1898 respectively.
12th " "	6	5	11	4	5	9	2	...	2	...	...	4	3	7	2	2	4	No cases up to 15th December 1898; Followers removed to camp on 13th December 1898.
15th " "	6	6	12	4	5	9	2	1	3	...	...	4	4	8	2	2	4	1 case, female; sent to Civil Plague Hospital; inoculated 3rd November 1898; re-inoculated 2nd December 1898.
16th " "	6	6	12	4	5	9	2	1	3	...	...	4	4	8	2	2	4	No cases.
17th " "	6	7	13	4	6	10	2	1	3	...	...	4	5	9	2	2	4	1 case, female, died, inoculated 1st November 1898.
18th " "	6	7	13	4	6	10	2	1	3	...	...	4	5	9	2	2	4	No cases.
19th " "	6	7	13	4	6	10	2	1	3	...	...	4	5	9	2	2	4	No cases.
20th " "	6	8	14	4	6	10	2	2	4	...	...	4	6	10	2	2	4	1 case, female; sent to Civil Plague Hospital; inoculated 9th November 1898.

Lieutenant R. W. Clements.

16th Dec. 1898.

Plague Return up to 20th December 1898 of Followers of " J." Battery, Royal Horse Artillery.

Date.	Total No. of Cases.			Total deaths in the lines.			Total transfers to Civil Plague Hospital.					Inoculated.			Not Inoculated.			Remarks.
										Result.								
	Male.	Female.	Total.	Male.	Female.	Total.	Male.	Female.	Total.	Recovered.	Died.	Male.	Female.	Total.	Male.	Female.	Total.	
28th October 1898 .	1	...	1	1	...	1	...	...	...	...	...	1	...	1	...	...	...	1 case, male, died; said to have been inoculated four days previously. No cases up to 18th November 1898.
18th November 1898	2	...	2	2	...	2	...	...	...	...	...	2	...	2	...	...	...	1 case, male, died, inoculated 3rd October 1898. No cases up to 22nd November 1898.
22nd " "	2	1	3	2	1	3	...	...	...	...	...	2	1	3	...	...	...	1 case, female, died, inoculated 27th October 1898. No cases up to 6th December 1898.
6th December "	3	1	4	3	1	4	...	...	...	...	...	2	1	3	1	...	1	1 case, male, died, not inoculated. No cases up to 14th December 1898.
14th " "	3	2	5	3	1	4	...	1	1	...	...	2	2	4	1	...	1	1 case, female; sent to Civil Plague Hospital;* inoculated 20th November 1898. No cases up to 16th December 1898.
16th " "	4	2	6	3	1	4	1	1	2	...	1	3	2	5	1	...	1	1 case, male; sent to Civil Plague Hospital;* inoculated 27th October 1898.
17th " "	4	2	6	3	1	4	1	1	2	...	2	3	2	5	1	...	1	No cases.
20th " "	4	2	6	3	1	4	1	1	2	...	2	3	2	5	1	...	1	No cases since 17th instant.

* The two cases sent to the Civil Plague Hospital died.

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Plague Abstract of Native Followers.

Corps.	Date.	Total No. of cases.			Total deaths in the lines.			Total sent to Civil Plague Hospital.					Inoculated.			Not Inoculated.			Remarks.
											Result.								
		Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Recovered.	Died.	Males.	Females.	Total.	Males.	Females.	Total.	
4th "Queen's Own" Hussars	From 25th October 1898 to 20th December 1898.	25	22	47	18	18	36	7	4	11	4	7	7	8	15	18	14	32	
"J." Battery, R. H. A.		4	2	6	3	1	4	1	1	2	...	2	3	2	5	1	...	1	
21st Field Battery, R. A.		6	8	14	4	6	10	2	2	4*	...	...	4	6	10	2	2	4	
25th Field Battery, R. A.		9	9	18	8	9	17	1	...	1	...	1	6	6	12	3	3	6	
Army Hospital Corps		1	...	1	...	...	...	1	...	1	1	...	...	...	...	1	...	1	
TOTAL	...	45	41	86	33	34	67	12	7	19	5	10	20	22	42	25	19	44	

* Still under treatment in Hospital.

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NATIVE FOLLOWERS.

Statement of Primary Inoculation.

Corps.	Men.	Women.	Children.	Total.	Remarks.
4th "Queen's Own" Hussars	430	379	259	1,068	
"J." Battery, R. H. A.	154	118	233	505	
21st Field Battery, R. A.	181	235	179	595	
25th Field Battery, R. A.	193	220	165	575	
Army Hospital Corps	4	3	1	8	
Total	962	955	837	2,754	

NATIVE FOLLOWERS.

Statement of Secondary Inoculation.

Corps.	Men.	Women.	Children.	Total.	Remarks.
4th "Queen's Own" Hussars	308	268	42	618	
"J." Battery, R. H. A.	164	178	70	412	
21st Field Battery, R. A.	100	110	13	223	
25th Field Battery, R. A.	122	93	25	240	
Total	694	649	150	1,493	

Abstract of Deaths from Plague in the Native Followers' Lines of the undermentioned Corps.

Corps.	Date.	Inoculated.			Not Inoculated.			Total.			Remarks.
		Male.	Female.	Total.	Male.	Female.	Total.	Male.	Female.	Total.	
4th "Queen's Own" Hussars	From 25th October 1898 to 20th December 1898.	3	7	10	14	12	26	13	18	36	Those died in Civil Plague Hospital after transfer are not included in this Statement.
"J." Battery, R. H. A.		2	1	3	1	...	1	3	1	4	
21st Field Battery, R. A.		2	3	5	2	3	5	4	6	10	
25th Field Battery, R. A.		5	6	11	3	3	6	8	9	17	
Total	...	12	17	29	20	18	38	33	34	67	

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4630. Can you give us any other particulars?—In the 4th Hussars and the 25th Field Battery, after the evacuation of the lines and removal, there were no cases. The 21st Field Battery lines were evacuated on the thirteenth, and there was a case this morning in their new camp. It is the first case I have of plague occurring amongst the re-inoculated. He was primarily inoculated on the 3rd of last month, and re-inoculated on the 2nd of this,—a month afterwards.

4631. He got plague to-day?—Yes, he got plague to-day.

4632. Have you any other data bearing on inoculation, I mean as far as numbers are concerned? Have you inoculated followers from any other regiment?—No.

4633. How did you estimate the dose you inoculated?—I used the dose put on the bottles.

4634. What effect did you find on the temperature: perhaps you had not time to take the temperatures?—I did not make any observations with regard to the effects of inoculation.

4635. Did you see any evil effects from inoculation?—I had no evil effects from inoculation. I may mention two cases in connection with inoculation. The first case that occurred in "J" Battery was on the 1st of November. The man was said to have been inoculated at the Ulsoor Depôt four days previously. He was stated to have died from inoculation. I enquired into the case very carefully.

4636. He was inoculated in the left arm, I take it?—I did not inoculate him myself, but he was one of the followers I was put in charge of with regard to inoculation. He was reported to have died from the effects of inoculation. It was pretty early in the inoculations, and I wanted to make absolutely certain about the case. I made enquiries as far as I could, and found that he had been drinking for at least three or four days previous to inoculation. He was practically on the verge of delirium tremens. He continued this drinking for two or three days following inoculation, so that it was an open question whether he died from alcoholism or from the inoculation.

4637. Do you know in what part of the body he was inoculated?—I did not see the man.

4638. Who saw the man, and under whose care was he?—He was one of the followers. There is a Hospital Assistant in charge of all the followers.

4639. (*Dr. Ruffer.*)—Could you give me the name of the man, and the name of the Hospital Assistant?—The man's name was Abboo. He was a syce 28 years of age. The Hospital Assistant was R. S. Rasapillay. I have received the following letter from him with regard to this case:—"With reference to the death of syce Abboo of 'J' Battery, Royal Horse Artillery, which occurred on the 28th October, I beg to state that on the said date at about 11 A.M., I was called on to see a man reported to be very ill in the Native Followers' Lines of the above Battery. Accordingly when I went over to the lines I found the man (Syce Abboo) with life already extinct. On enquiry touching his illness, I was informed by the relatives of the deceased that he was inoculated against plague four days previously at Ulsoor Depôt, and had since then been suffering from fever and vomiting, which, they said, ended in his death. As I could gather no other information from them, and had not seen and treated the man when he was ill, or examined the body after his death, I beg to state that I am unable to conclude whether he (Syce Abboo) died of plague or from the effects of inoculation." This man was said to have been inoculated at the Ulsoor Depôt four days previously. There was another case—a grass-cutter in one of the Field Batteries. She died ten days after inoculation. It was talked about in the lines that she had died from inoculation.

4640. Did you make any enquiries about that case?—Yes, I found that she had been ill only three days after inoculation. The week before she died she was baking and selling rice-cakes in the followers' lines.

4641. You say she died ten days after inoculation: when did she fall ill after inoculation?—She was only ill the night before she died. She died quite suddenly.

4642. Do you know any cases with abscesses and very bad arms?—No, they would be brought to my notice. The Hospital Assistant was instructed to do so, as he did in these two cases.

4643. You have no reason to believe from your own experience that inoculation is followed by any evil effects?—No, I should say quite the contrary.

4644. No evil effects?—No.

4645. (*Mr. Hewett.*)—In the case of the 4th Hussars, you re-inoculated 618. How many did you re-inoculate in the other cases?—Four hundred and twelve in the Royal Horse Artillery; 223 in the 21st Field Battery, and 240 in the 25th Field Battery.

4646. They all had the full dose?—In every case.

4647. Why did you give them a second dose?—I got the order to proceed forthwith.

4648. You received the order to give a second dose?—Yes.

4649. But you did not succeed in giving them all a second dose?—No.

4650. The order was that everybody was to be re-inoculated?—Yes.

4651. You do not know anything about the origin of the order?—No.

4652. I suppose if you determined to evacuate these lines you could get the people out in the same morning?—Yes, in an hour.

4653. Are the Horse Artillery followers still in their lines?—Yes.

4654. Do you propose to evacuate their lines?—I have not heard anything about it.

(Witness withdrew.)

MAJOR T. DALY, R.A.M.C., called and examined.

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4655. (*The President.*)—You are in the Royal Army Medical Corps, and in medical charge of some troops?—Yes, I am in charge of the Second West Riding Regiment.

4656. Have you had much experience with regard to inoculation?—No, it has been limited. I have inoculated about seventy-two of the followers of the regiment, and ninety-four men of the regiment.

4657. (*Dr. Ruffer.*)—What was the total number of followers of the Second West Riding Regiment?—Two hundred and forty-two.

4658. Is that the correct number?—I got it from Quarter-Master of the regiment, who pays them.

4659. You have no reason to believe that the number of followers was larger than that?—No.

4660. How many followers did you inoculate?—Seventy-two; fifty-eight followers of the Second West Riding, and fourteen of the Army Hospital Corps men, seventy-two followers altogether. There were fifty also inoculated in the town at the Village Depôt.

4661. That is forty-eight *plus* fifty which equals ninety-eight?—Yes.

4662. How many times did you inoculate them?—Once.

4663. All once?—All once.

4664. Taking first the followers of the Second West Riding did you have any cases of plague or deaths from plague before the inoculation began?—It was reported to me that two followers of the regiment died.

4665. You had two cases of plague?—It was reported to me that two men had died, two men of the sweeper class. As far as I have been able to find out they died before October 20th, when inoculation began. Perhaps I had better tell you that the followers of an Infantry regiment have no lines like the followers of the Cavalry and Artillery have. They live in the bazars. They come to work in the morning about six or half past, and leave in the evening. These men who were inoculated went home.

4666. They lived with their families?—In the bazars. They were absent from their duties about five days when they were inoculated. They said they were sick for five days.

4667. You did not inoculate their families?—No, we had nothing to do with their families.

4668. How many cases of plague have you had since inoculations began?—It has been reported to me that two men, two cooks, died of plague since the 20th October when the inoculations of the followers began. They were two men inoculated in the town. It was reported to me that

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they did not come back to barracks. They died four or five days after inoculation.

4669. Among the uninoculated there have been no death since the inoculation ?—No, as far as I know.

4670. Then you are not certain of the numbers ?—No, because we lose sight of them altogether in the barracks.

4671. (*The President.*)—Are you quite sure that those who died and had been inoculated, died of plague ?—I enquired of the Quarter-Master of the regiment: he was not quite sure. I asked the other cooks of the regiment who knew these people, and they said they were inoculated, and that they died within five days. They say it was plague. I have only their word for it.

4672. (*Dr. Ruffer.*)—Did you notice any evil effects among the inoculated from the inoculation, in the followers ?—None have come before me. I never saw the followers once after inoculating them.

4673. They stayed away for some time ?—Yes, until they were fit to come back to barracks.

4674. And they said it took five days ?—Yes.

4675. Did you believe that statement to be correct ?—Judging by the effects of inoculation on the British troops, I do think it is correct.

*4676. When they came back I suppose they were quite fit for their duty ?—Yes.

4677. You have inoculated fourteen men in the Army Hospital Corps ?—Yes, natives.

4678. Had there been any deaths among them before from plague ?—One man got plague the morning we began inoculation. I found when we went round the quarters to see the men that there was one man ill. It was thought at the time that it was plague. He was sent to the hospital, and it turned out to be a case of plague.

4679. He was not inoculated ?—No.

4680. You inoculated fourteen others ?—Yes.

4681. Have you had any evil effects from inoculation among them ?—None.

4682. Were there any deaths among the fourteen inoculated followers ?—None.

4683. Did you have any in the Army Hospital Corps men who were left uninoculated ?—None.

4684. Have you inoculated any soldiers besides ?—I inoculated ninety-four men and two officers of the Second West Riding.

4685. That is a European regiment ?—Yes.

4686. Had there been any deaths from plague in the regiment before ?—No, none.

4687. And since ?—A man of the regiment died a few days ago.

4688. He had not been inoculated ?—No, he had not been inoculated.

4689. This man died of plague; did you trace how he got infected ?—No, we did not. He was a man belonging to Army Temperance Association. There was a bungalow in the barracks told off for the Association, and this man was in charge of it. He lived in it: he was the only person who slept there. There have been various conjectures, but we have been unable to trace it.

4690. You have found nothing tangible ?—No.

4691. I suppose you had opportunities of observing very carefully the men, the Europeans, who had been inoculated ?—Yes; they were struck off duty, and came to the hospital every morning.

4692. Did you take their temperatures ?—No.

4693. Did you examine their arms ?—Yes.

4694. Did you find any marks ?—They were inoculated, as a rule, about four or half past, and the next morning their arms were swollen and stiff. The second morning their arms were red, and for about four days they were red and swollen as far down as the elbow joint, and often in the inside of the arms.

4695. Were they inoculated in the left arm over the biceps ?—Yes, at the back.

4696. Did you notice that the swelling extended more downwards than upwards ?—Always more downwards in every case.

4697. That is the rule ?—Yes, that is the rule.

4698. Did you notice any buboes in the axilla of the men, or enlarged glands ?—No.

4699. Did you look for them ?—I did.

4700. You found no swelling ?—No.

4701. Did you find that any of the men vomited ?—The men complained to me the next day that they had vomiting and diarrhœa during the night.

4702. Did any of the men faint ?—No.

4703. Were there any abscesses ?—No, not one.

4704. You have had no other experience ?—No.

4705. (*Prof. Wright.*)—I understand that the ninety-four men of the Second West Riding went round the town, and were exposed to infection ?—Yes, they go round with the Medical Officers: they are employed on house to house visitation.

4706. Are the other soldiers allowed to go into the town ?—There have been no orders preventing them, as far as I am aware. I think they go very little: as a matter of fact the infantry do not go into the bazars.

(Witness withdrew.)

LIEUTENANT H. HEWETSON, R. A. M. C., called and examined.

Lieutenant H. Hewetson.

16th Dec. 1898.

4707. (*The President.*)—You are in the Royal Army Medical Corps ?—Yes.

4708. In charge of troops here ?—Yes, together with Lieutenant Clements.

4709. In what Regiment ?—I am in charge of the Artillery. Mr. Clements and myself have been inoculating. He has done by far the greater number of inoculations. I have helped him on two or three occasions. That is how my name is before the Commission. He has, in his evidence, put in all the statistics with regard to it.

4710. (*Dr. Ruffer.*)—Are your figures the same as Mr. Clements' ?—Yes, they are my figures.

4711. Do you agree with everything that he has said ?—Yes.

4712. Is there anything you would like to add to Mr. Clements' evidence ?—No, I have nothing to add to it.

(Witness withdrew.)

CAPTAIN CARR WHITE, I.M.S., called and examined.

Captain Carr White.

16th Dec. 1898.

4713. (*The President.*)—You are in the Indian Medical Service, I think ?—Yes.

4714. You have done a good deal of inoculation I believe ?—Yes, I have done a good deal amongst the native troops and followers.

4715. (*Dr. Ruffer.*)—Could you tell us the Regiments and the followers you inoculated ?—The 17th Madras Infantry, the Transport Ambulance, and the Transport Department.

4716. Both the Regiment and followers ?—Yes.

4717. I will take you over the Regiment, and the followers and the Transport separately. Without entering into details, could you tell us the total number of plague cases and deaths in the 17th Madras Infantry up to the time you began inoculations ?—There were two cases amongst the uninoculated after we started inoculating.

4718. Before inoculation ?—We had no cases before starting inoculation. They were not all inoculated on the same day: but two cases occurred amongst those who had not been inoculated after we had started.

4719. What is the total number of the inoculated ?—One thousand four hundred and ninety-five; that includes men, women and children in the Regiment, the number inoculated in the 17th Madras Infantry Regiment being :—

Native officers, rank and file	736
Women	333
Children	410
Followers	16
	1,495

4720. How many uninoculated?—They have all been inoculated.

4721. Every one?—Yes, they have all been once inoculated.

4722. Any of them twice?—Yes, there have been 642 men, 237 women, and 410 children inoculated a second time.

4723. What is the number of cases of plague you have had in these men since inoculation?—Nine men and four children, total 13.

4724. How many deaths?—Eight men and three children, total 11. There are two still under treatment.

4725. They have all been inoculated, so that there are no deaths among the uninoculated?—We had two deaths amongst the uninoculated, but those occurred after we had once started inoculation.

4726. Among the followers of that Regiment?—I have inoculated the whole of them.

4727. You have put them all together under that total. Did you evacuate that Regiment?—No, they remained in their lines all the time.

4728. These men are all natives?—Yes, except for a few Eurasians belonging to the band.

4729. Are the officers natives?—There are usually 16 native officers to a regiment.

4730. How many officers are Europeans?—I think altogether there are eight European officers.

4731. Were any Europeans not inoculated?—Yes; the remaining officers were not inoculated. I think there were two who were not.

4732. There have been no deaths?—No plague and no deaths amongst the European officers.

4733. Now with regard to the Transport: what is the strength?—One thousand one hundred and thirteen inoculated men, women and children.

4734. They were all inoculated, everyone?—Yes, everyone.

4735. Did you evacuate the transport followers?—No, they remained in the lines.

4736. How many deaths were there before the inoculation was begun?—There were three cases up to the time of inoculation.

Captain, Carr White.

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4737. How many deaths?—One death.

4738. Since the inoculation, how many cases of plague have there been?—Five cases.

4739. Do you put in figures showing the number of days after inoculation when the symptoms appeared?—Yes, as follows:

1st 36 days after inoculation.
2nd 49 „ „ „
3rd 51 „ „ „
4th 52 „ „ „
5th unknown, said to have been inoculated by the Civil authorities.

4740. And the number of recoveries and deaths?—Yes; of the 5 cases, 3 recovered and 2 died.

4741. Did you notice anything special in the inoculated people after inoculation, any severe or dangerous symptoms?—I have never found any dangerous symptoms; a few fainted soon after.

4742. Any vomiting?—I have had a few with severe vomiting, and diarrhœa for a few hours.

4743. Any abscesses?—Three abscesses occurred.

4744. Any buboes?—No buboes.

4745. What was the dose you used?—The adults had pretty well the full dose.

4746. The full dose as written on the bottle?—Yes, the bottle. If it was 10 c. c. strength, they had 10 c. c.

4747. Did you take the temperatures of these people?—A few of the temperatures were taken.

4748. What was the rise of temperature?—The temperature varied a good deal. Some of them did not have much reaction, some 100, and some went up to 104.

4749. Did you find that the arm was painful after inoculation?—In some cases it became very painful.

4750. Were they able to go back to their duty the next day, or did you have to put them on the sick list?—On an average I found they required about a week before they could return to their duties. The sepoys could not use their arms well enough to return to their duties much under a week.

4751. Did you examine the swelling at the point of inoculation in many of these men?—In nearly all of them in the 17th Madras Infantry.

4752. Did you find that the swelling had a tendency to gravitate downwards?—Yes; I found it gravitated downwards.

4753. At the elbow joint, round the elbow joint and specially at the back?—It was principally at the back of the arm.

4754. You had no cases of sudden deaths after inoculation?—No, none.

(Witness withdrew.)

Mrs. I. F. A. Batten, called and examined.

4755. (*The President.*)—I believe you are a Doctor of Medicine?—Yes, of the University of Brussels and L.R.C.P.S. of Edinburgh.

4756. Have you done many inoculations?—I have done a few. Only the women and children and some of the followers of the 1st Madras Pioneers.

4757. (*Dr. Ruffer.*)—What is the total number of women and children among the followers of that regiment?—Twenty-six women followers living in the lines. There are other followers not living in the lines. There are 698 regimental followers, that is, the wives, and children of the sepoys.

4758. Your experience extends over the whole of that?—I did not do the whole. A few were done by outsiders, and a few Miss Lillingstone did.

4759. What numbers did you do?—I did 625 altogether.

4760. Had there been any cases of plague amongst the women and children before inoculation?—None.

4761. Since inoculation how many deaths have you had from plague?—None among the women and children in the regiment.

4762. No cases of plague, and no deaths?—There was one case—a woman not living in the regimental lines. She was an outside follower, and died twelve days after inoculation. There were none at all in the regimental lines.

Mrs. I. F.A. Batten.

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4763. Did you notice any evil symptoms after inoculation?—I saw several interesting cases. One case was inoculated on the 31st October. Three days afterwards I saw her. She was enormously swollen, and had extreme œdema. She had been inoculated in the left arm. It was enormously swollen. I took some urine to test. The next morning they came over to say she was dead. I made all the enquiries I could, and they told me a most extraordinary story. However, she had a fair amount of albumen in the urine, and I presume she was a subject of Bright's disease. The albumen was small compared with the enormous œdema. I believe she had been ill two months previously. They were under the impression that she was pregnant. At that time she had high fever and was swollen, but not so much as after inoculation. They sent for a native doctor, and they say that the pregnancy disappeared, and that she recovered and that a great deal of water was passed at that time. I presume it was a case of hydro-nephrosis. After inoculation she had a fresh attack which caused her death.

4764. You do not think that death had anything to do with the inoculation?—My own impression is that she probably would not have had the attack at that time had she not been inoculated.

4765. At the time you inoculated the woman you noticed nothing special in her?—No.

4766. But when you saw her she had well marked œdema, *Mrs. I. F. A. Batten.*

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she was enormously swollen?—Very much swollen, very much indeed.

4767. This œdema could not have come on suddenly: it must have lasted some days?—I saw her the very day after inoculation. I was told not to inoculate pregnant women and children under six months old. I asked two or three women to help me, who spoke English, and they came up with the story I have just told you,—that it was a previous pregnancy. When I saw her, she was apparently well. She swore there was nothing of that sort, and she was inoculated.

4768. You think this enormous œdema had come on between the date of inoculation and the time you saw her on the 3rd day?—Certainly it had.

4769. (*The President.*)—How long before was the pregnancy you speak of?—Her husband said that if she had gone on her full time, it would have been the 9th month at the date of inoculation. But I do not think she was ever pregnant before. I think the swelling was possibly due to hydronephrosis.

4770. How long was the interval between the disappearance of this abdominal swelling and inoculation?—Two months.

4771. (*Dr. Ruffer.*)—Have you any other case you would like to speak about?—Another case which interested me very much was that of a small child, five years of age, inoculated on 2nd November 1898. I noticed the day it came that it was very lively and talkative. In the afternoon after inoculation they say the child had a fit. I saw it two days after inoculation. I never saw anything like it. It then had something like extreme chorea. Its legs were paralysed. Its hands were turned in, and its feet turned out,—there was extreme opisthotonos. It was twisted up in a most extraordinary way The mouth was tightly shut. It did not appear to know anybody or to understand anything.

4772. Did the child bite its tongue?—They said it had not. I could not open its teeth at all.

4773. That sounds very much like an epileptic fit?—This was two days after. It could not have been in this fit all that time. I fed it with a little milk. After about a week it gradually began to open its mouth. The movements still continued extreme. In about six weeks the child could put its feet to the ground, but it could not talk. Its mind seemed quite gone.

4774. Had it any temperature?—No; the temperature was rather subnormal.

4775. Did it remind you of tetanus?—The only symptom like tetanus was the tight closing of the jaw: otherwise it was very like an exaggerated case of chorea.

4776. It had opisthotonos?—An extremely rigid neck and some arching of the body.

4777. Is this child alive now?—It is alive and improving. It can walk now but it cannot talk. Apparently it still does not know its parents. When I saw it three days ago, they had its mouth tied up. They say it tears everything with its teeth like an animal.

4778. Where is the child?—The father is a Jemadar in the Pioneer lines. The child can walk now. It has made wonderful progress since I saw it first. (Note by witness dated 6th March 1899—Up to date this child has not spoken nor does it appear to recognise its parents, although the choreic symptoms have passed off and its general health is improving.)

4779. Have you had any other cases of a similar kind? – No, not a similar kind. I have not heard of another case like it. Then there was its heart. I have read somewhere that occasionally inoculation has bad effect upon the heart and this might be expected with symptoms like chorea. There was a loud hæmic murmur, but I could discover nothing else. There was one other case, and that was also a case of pregnancy, but I did not perform the inoculation. I was asked to come down and see the woman; I saw her one month after inoculation. She was then extremely weak from excessive vomiting.

4780. Those are common symptoms in pregnancy?—Yes; but she had not had vomiting before inoculation. She was extremely weak at the time. I took her to Miss Lillingstone's hospital where she died the same day. I think if she had been taken earlier possibly she might have lived.

4781. Have you had any abscesses?—I have seen three myself, and the Hospital Assistant tells me that there have been others. I noticed that these were all in Hindus. I made enquiries, and I discovered they had been poulticing their arms with some decoction of salt and rags. These are the people who have had abscesses.

4782. What precautions did you take as to antiseptics when you inoculated these people?—I had their arms washed with a solution of carbolic.

4783. What strength?—1 in 20. I had the syringe kept in a five per cent. carbolic solution. At first we strained the prophylactic fluid through antiseptic gauze.

(Witness withdrew.)

MISS LILLINGSTONE, called and examined.

Miss. Lillingstone.

16th Dec. 1898.

4784. (*The President.*)—I understand that you are a Licentiate of the Royal College of Surgeons and Physicians?—Yes.

4785. (*Dr. Ruffer.*)—I think you have had some experience in inoculation?—Yes; I have inoculated for the Cantonment.

4786. How many have you inoculated?—One thousand and ninety-seven.

4787. Belonging to one regiment?—I have not tabulated them according to their regiments. I have also re-inoculated 128, making a total of 1,225 inoculations.

4788. You have inoculated 1,097, and re-inoculated 128; have you had any deaths among these inoculated people?—I fancy that one case to which Mrs. Batten referred was one of my operations. It was not from plague.

4789. The case of œdema?—No, the case of the woman who was three months pregnant and began to vomit afterwards.

4790. Did the vomiting in this case differ in any way from ordinary vomiting in pregnancy?—I did not see the woman from the day I inoculated her to the day she was brought to the Zenana Mission Hospital; she died same day.

4791 You cannot be sure if you have had any other deaths among the inoculated?—No.

4792. Did you notice any abscesses?—I saw two abscesses.

4793. In persons inoculated from the same bottle or from different bottles?—From different bottles, I think; I thought it was entirely due to outside contamination, and had nothing to do with the inoculating fluid. The needle was very large, and the wound was quite sufficient. There was track enough for any amount of sepsis afterwards.

4794. Have you seen any other severe symptoms after inoculation?—There was one woman who has a child which had certain symptoms of chorea, and it seemed to me that it began again.

4795. Have you seen any sudden deaths after inoculation?—No.

4796. Are there any other facts you would like to bring before us with reference to inoculation?—I do not think I have any more to say.

4797. Have you found any difficulty in getting women and children to be inoculated?—I have been disappointed that the Muhammadan civilian population have not come forward more.

4798. The women have not?—I think the majority of my Muhammadan women have been from the regiment.

4799. (*The President.*)—Do you always adhere to the dose put on the labels of the bottles?—I have not given full doses to women; I have given ⅘ths of the dose.

4800. You modify the dose according to sex, but otherwise you adhere to the dose?—Yes.

4801. Have you ever given a large dose?—In one instance I gave a coolie woman more than the dose. There were no evil effects from it.

4802. But none of the fluid supplied to you is *required to* be injected in a bulky quantity?—No.

4803. Generally speaking, what has been the dose for an adult?—It varied. I began with 10 c.c., then 7½ c.c., and lately 5 c.c.

4804. That is the variation stated on the label on the bottle?—Yes, the variation stated for each brew.

4805. You did not vary it on your own account?—No.

4806. You adhered altogether to the doses directed to be given?—Yes

(Witness withdrew.)

Mr. T. V. Armugam Mudaliar, called and examined.

Mr. T. V. Armugam.

16th Dec. 1898.

4807. (*The President.*)—You have been employed in inoculations in the city of Bangalore, I think?—Yes.

4808. Have you done a great many inoculations?—Yes.

4809. (*Dr. Ruffer.*)—I am informed that you inoculated a Native Regiment?—Yes.

4810. What is the name of the Regiment?—Mysore Native Sepoy Regiment.

4811. What is the total strength of the Regiment?—1,100, including families.

4·12. How many cases of plague and how many deaths had you in that Regiment before the inoculations were begun?—Thirty-nine cases and thirty deaths.

4813. That is among uninoculated people?—Yes.

4814. Since the inoculations were begun, how many deaths have you had?—Twenty-nine attacks and fifteen deaths,—among the uninoculated.

4815. When were the inoculations done?—Nine on the 24th of October.

4816. Have these people been re-inoculated?—Only one. All of them were not inoculated on one day: they were inoculated on different days.

4817. How many of this total number of people have been inoculated?—769.

4818. How many cases of plague have you had among the inoculated?—Five.

4819. How many deaths? One death.

4820. How many have you had among the uninoculated?—Sixty-three attacks with forty-four deaths.

4821. Among the inoculated, how long after the inoculation did the cases of plague occur: can you give us a table showing that?—No. I have not prepared a table.

4822. Could you prepare a table showing the exact date after inoculation at which the symptoms appeared: have you got notes to that effect?—I have not.

4823. Do you know whether any of them died immediately after the inoculation, or shortly after the inoculation?—I was told by the Assistant in charge of the Regiment that men died three days after the inoculation.

4824. Died from plague?—Yes, died from plague.

4825. In the city of Bangalore itself you have performed 22,194 inoculations, is not that so?—I have done about 15,000 myself.

4826. How many second inoculations have you done? I have done about 500 or 600.

4827. Do you know the exact number?—I do not know the exact number.

4828. Do you not keep a register?—Yes.

4829. Then you could look up the exact number?—Yes. (The witness intimated later that the number was 1,356.)

4830. Have you any idea of the number of deaths amongst the people you inoculated?—They were reported to me.

4831. Are the numbers contained in Dr. Benson's evidence?—He gives the total deaths.

4832. What are the symptoms you observed after inoculation?—Fever and swelling.

4833. In how many cases did you take the temperature?—I do not know; I cannot exactly say. In the gaol and one Ward I took a large number.

4834. How many, about?—About fifty, I think.

4835. How long after the inoculation?—One day after the inoculation.

4836. Twenty-four hours?—Yes.

4837. What is the maximum temperature you got?—One hundred and four.

4838. What was the average?—I did not strike the average: it averaged between 99 and 104.

4839. Were the majority above 102 or below 102?—The majority were below 102.

4340. Were they all first inoculations?—Yes, they were all first inoculation.

4841. What was the character of the fever they got after inoculation?—In some cases it was intermittent, and in others it was remittent.

4842. On what other observations did you base that conclusion,—that some were intermittent, and some remittent? Did you take the temperature at stated intervals?—The patients told me that they were completely free from fever.

4843. In some cases you say the patients suffered from an intermittent type of fever,—is that based on thermometric observations made by yourself, or based upon what the patient told you?—In some cases upon my own observations, and in others, what I was told by the patients. My opinion on the varieties of fever produced after inoculation with Professor Haffkine's fluid, and other details referring to fever after inoculation is based mostly on the observations of the Hospital Assistants of the Jail and the Lunatic Asylum at Bangalore, where I inoculated a large number of prisoners and lunatics, and on the observations made by other medical officers who were inoculating at Bangalore in the latter part of this year.

4844. Take your own observation first. How often did you take the temperature in those cases?—Twice.

4845. What did you notice?—In the morning intermission in some cases, and only slight remission in others.

4846. In some cases the temperature went down to normal?—Yes.

4847. And went up again in the afternoon?—Yes.

4848. (*The President.*)—I understand you made only two observations in any single case?—Yes.

4849. (*Dr. Ruffer*).—What were the local symptoms? I take it that you inoculated them in the left arm?—Yes.

4850. What did you notice in the arm?—Swelling.

4851. Did you ever have abscesses?—I saw one, and I was told of two abscesses.

4852. Did any get abscesses in the cases you inoculated?—I was told that in one of the cases I inoculated there was an abscess. I was told of the other two.

4853. I think you got cellulitis of the whole arm?—Yes.

4854. From the wrist up to the shoulder?—Yes, the inflammation ran down. It began at the seat of inoculation, and spread downwards.

4855. Did it spread upwards at all?—No.

4856. Did you get any enlarged glands in the axilla?—No.

4857. Did you notice any difference between Europeans and natives in the severity of the symptoms after inoculation?—Yes.

4858. What did you notice?—The Europeans had a higher temperature than the natives.

4859. Did they suffer more pain?—They complained of more pain.

4860. Were the constitutional symptoms more marked?—Yes.

4861. Were the local symptoms more marked? Do you think the swelling more marked in the Europeans than in the natives?—No, I think not.

4862. In the précis of your evidence you say the local symptoms after inoculation were more marked: what do you mean by "local symptoms" if local swelling was not marked?—The redness was more marked in Europeans than in natives.

4863. Did you find that children could bear larger doses than adults?—Not larger: the children got very small doses.

4864. The symptoms were not so marked?—Not so marked.

4865. You say you inoculated a baby thirty days old?—Yes.

4866. Did you notice any thing special in that child afterwards?—No, nothing.

4867. And old people bore the inoculation very well?—Yes.

4868. (*The President.*)—What dose did you give this baby relatively to an adult's dose?—I gave the baby ⅛ c.c. out of a 10 c.c. adult dose.

4869. (*Dr. Ruffer*).—Do pregnant females take the inoculation well?—Yes.

4870. I believe you have some observations on the effect of the inoculation in other diseases?—Yes. Dyspeptics had told me that their appetites had improved after the inoculation.

4871. Do you attribute that to the fever they went through?—I cannot say.

Mr. T. V. Armugam.

16th Dec. 1898.

4872. Does the same apply to cases of asthma?—Yes, I was told so by asthmatic patients.

4873. Did you notice any improvements in other conditions?—No.

4874. (*The President.*)—Were you only told about it or did it come under your observation?—I was told about it; it did not come under my own observation.

4875. Did the dyspepsia cases come under your own observation?—I was told about them.

4876. (*Dr. Ruffer*).—To go back to the Regiment you were speaking about just now. I believe that Regiment was evacuated out of barracks and sent outside?—Yes.

4877. How many cases of plague had you had up to the time of evacuation?—Thirty-nine.

4878. Then the Regiment was ordered out?—Yes.

4879. How many cases of plague did you have afterwards?—Twenty-nine.

4880. How long has the regiment been sent out of barracks?—Sixty-one days.

4881. When was the last case of plague in that regiment?—Yesterday.

4882. When was the first case of plague in that regiment?—The 25th September.

4883. It was sent out two months ago?—Yes.

4884. So that there were about thirty-nine cases from the 25th September to the 25th of November?—To the 16th of October: that was the day of evacuation.

4885. It has had twenty-nine cases since?—Yes.

4886. The last case was yesterday?—Yes.

4887. Can you give us the dates of the other cases?—They are all recorded in the hospital.

4888. Did the majority of cases occur shortly after the evacuation, or lately?—I shall have to refer to the register before I can answer the question.

4889. Could you send us a note of the exact date of these cases?—Yes. (The following table was supplied later by the witness:—

Statement of Plague cases which occurred among the Native Sepoys at Bangalore before and after evacuation of lines.

Date of attacks.	No. of attacks.	No. of recovery.	No. of deaths.	REMARKS.
25th September 1898	3	...	3	First appearance in the lines.
28th " "	1	...	1	
29th " "	1	...	1	
30th " "	1	...	1	
1st October 1898	1	...	1	
3rd " "	1	...	1	
12th " "	3	...	3	
13th " "	9	4	5	
14th " "	4	2	2	
15th " "	3	1	2	
16th " "	6	2	4	* Date of evacuation of the lines.
17th " "	6	0	6	
18th " "	8	3	5	39 cases with 30 deaths.
20th " "	4	1	3	
21st " "	3	1	2	
23rd " "	2	...	2	
24th " "	2	2	...	
25th " "	1	1	...	
26th " "	2	1	1	
27th " "	2	1	1	
23rd November 1898	1	...	1	
7th December 1898	1	...	...	
8th " "	1	1	...	
9th " "	2	...	...	29 cases with 15 deaths.
TOTAL	68	20 + 3*	45	* 3 Remaining.

Total number of cases occurred before the evacuation (*i.e.*) from 25th September 1898 to 17th October 1898—39 with deaths.

Total number of cases occurred after the evacuation (*i.e.*) from 18th October 1898 to 17th December 1898—29—15).

Mr. T. V. Armugam.

16th Dec. 1898.

4890. (*Mr. Hewett.*)—Are the men in camp allowed to visit the city?—Yes.

4891. Are there no restrictions?—No.

4892. Were the people in the regiment who were not inoculated left uninoculated at their own wish, or because they were ill or weak?—No; they did not wish to be inoculated in the beginning.

4893. You say the doses were marked on the bottle all the way through?—Yes.

4894. Some of these inoculations have not been performed by you: who performed them?—Some were performed by Colonel Benson, and some by an assistant of mine.

4895. An Assistant Surgeon?—Yes, an Assistant Surgeon.

(Witness withdrew.)

MR. A. M. SLIGHT, I. C. S., called and examined.

Mr. A. M. Slight.

16th Dec. 1898.

4896. (*The President.*)—I believe you are the District Magistrate of Bangalore?—Yes.

4897. I shall be obliged if you will answer a few questions with regard to the milk supply in Bangalore?—Certainly.

4898. First, are there public dairies?—Yes, there are several public dairies. Most of them only get milk from an ordinary cowkeeper who usually keeps his cows in a very dirty yard attached to his house. There are several fairly large dairies which call themselves by English names. Most of these cowkeepers milk their cows early in the morning, and take all the milk to these dairies where they sell it to the dairy-keeper. The dairy-keeper separates the milk, takes the cream for making butter and so on, and re-sells the separated milk back to the cowkeeper at a much cheaper rate. This separated milk is what the bulk of the people use.

4899. There are smaller collections of cows, one or two in separate buildings?—Yes.

4900. Are they kept in an equally dirty condition?—The majority of them are kept in very dirty condition.

4901. Is there any separate shed, generally, in which they are kept?—Yes; they have a shed in the yard.

4902. Is that under the same roof as the dwelling?—Very often.

4903. Inside the dwelling?—Yes, inside,—very rarely inside a house, but very often covered by the same roof, and the living room of the man opens into the yard.

4904. But they are sometimes also inside the house, I think; is that within your knowledge?—Oh, yes. You see cows living practically in the house.

4905. When there are only one or two cows kept in the house, how is the milk disposed of?—A few of these men sell their milk direct to regular customers, sell the pure milk; but the majority of them take it to the big dairies.

4906. And in those cases where it is sold directly to the customers, have you any knowledge of those customers; are they immediate neighbours of the person who sells the milk?—In such cases it is usually a few neighbours.

4907. They come to the place and take the milk?—Or the milkman sends it round.

4908. Do you know what time the cows are milked?—In the early morning, about six o'clock.

4909. After being milked, where is that milk kept?—It is usually taken at once to the dairies.

4910. But in this case it may be distributed from his house?—It is kept in vessels, brass vessels, or earthen vessels, either in the milkman's house itself, or in some place about the yard.

4911. Until it is distributed, or until the neighbours come and buy what they want?—Yes; it is open all the time to a very great deal of contamination.

4912. I was going to ask you more about that. In this yard, besides the accommodation for the cows, what other ordinary accommodation do you find? Are there, frequently, for example, privies in this yard?—Yes; very often the privy of the house is in the corner of the yard.

4913. Give us a description of it?—Usually it is merely a little open space. Recently we have imposed Municipal bye-laws which are pretty strict, but we have not yet been able to enforce them in all the small houses. It is necessarily a difficult matter getting all the small houses to take up the importance of such things.

4914. Is there ever a well in this yard?—Very frequently there is a very dirty well, which gets full of cow-dung and dirt generally. Very often, I think, the water in such a well is full of contamination, and it is used to water the milk with before it is distributed. That is very common.

4915. And it would naturally be used to clean the vessels with?—Yes.

4916. And to dilute the milk?—Yes. The milk is nearly always diluted: in fact you may say always. Now of course, the pipe water-supply has just been completed in this station, and we have drafted Municipal bye-laws which are ready to come into force, and which will enable us to close up all these dirty wells, and make the people get their water from a clean source. But that is still rather in the future.

4917. They will get water from the standard pipes?—Yes.

4918. The standard pipe water seems to be discoloured?—It is rather muddy still.

4919. Would it not suggest adulteration if it were added to the milk; would it not altogether discolour the milk?—It might make it a little dirty, but I think not more so than what is commonly added to the milk. The well water is really quite as dirty.

4920. Do you think so in colour?—In many cases.

4921. In some cases I have seen it quite colourless?—In some cases it is fairly clean in appearance.

4922. Is this well-water protected from the drainage in the immediate neighbourhood?—No; such wells are open to all the soakage of the dirt in the yard. They are horrible places sometimes.

4923. Assuming for one moment that this milk may be contaminated with plague bacilli and taking into account what you have said that in some cases it would be distributed to the immediate neighbourhood, it is quite possible to conceive that in the first instance the milk would largely be distributed to the houses in the immediate neighbourhood?—It is possible, but I think it is not probable; because the people who get their pure milk direct from the milkman are only a very small number of the better class. They have to pay dearer for getting pure milk direct from the cow, and the majority get separated milk which has been to the dairy, and is therefore a mixture of milk which comes from various cattle yards.

4924. May not these smaller dairies also skim the milk and distribute the skimmed milk?—I do not think the natives skim the milk at all, because the small people do not have sufficient to make butter with, or anything of that sort.

4925. They do not make ghee?—No, these small people do not make ghee.

4926. (*Mr. Hewett.*)—How do the natives here treat the milk before they use it?—They say they always boil it.

(Witness withdrew.)

(Adjourned to to-morrow at Guntakal.)

Mr. E. A. Elwin.

17th Dec. 1898.

At The Guntakal Railway Station.

FIFTEENTH DAY.

Saturday, December 17th, 1898.

PRESENT :

PROFESSOR T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROFESSOR A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX. (*Secretary*).

MR. E. A. ELWIN, I. C. S., called and examined.

4927. (*The President.*)—You are Collector in the Bellary District ?—Yes.

4928. Could you tell me the extent of that district ?—I am afraid I cannot give it to you exactly.

4929. It is a large district I believe ?—Yes, it is about 100 miles by 100 miles.

4930. What is the population roughly ?—The population is about 12 lakhs.

4931. You have had a good many villages infected with plague ?—I have had two villages infected indigenously. There would be five or six including those indigenously infected.

4932. Taking those in which plague had been imported, and had become indigenous, have you any information to give us as to how it was imported ?—By travellers coming in from the infected areas, either by rail or by road.

4933. Do you get early information of each case in these villages ?—Yes, I think I may say so. I think in almost all cases the persons were provided with passports, binding them to present themselves for inspection daily for ten days after arrival. It was practically in consequence of this passport system that they were detected.

4934. In these instances the passport system seems to have been very valuable ?—Yes.

4935. What was the nature of the measures you employed ?—The chief measure was to get people out of the houses in which they were staying, and to isolate them. We also removed any persons that we found or suspected as being in contact with them. We then disinfected the houses by the methods laid down by our rules,—the ordinary methods.

4936. Excluding the indigenous, there were four ?—I think there were only three.

4937. And in those three villages what was the success that attended upon these measures ?—The success was perfect,—no bad results at all.

4938. Can you remember at what dates the imported cases occurred in the three villages ?—At one place on the frontier there have been several cases from September onwards,—about four or five cases. At another village there was a case about a month ago. In Bellary town there were two cases,—one at the end of last month, and one about the 6th of this month. The contacts were discharged yesterday, I think, in good health.

4939. And in none of these villages has there been plague contact ?—We have some cases at present not yet cleared up. There were three imported cases found in a village two or three days ago. The persons who were in contact with those cases are still under segregation. We do not know the results yet. But so far, they have been perfectly successful. There have been no indigenous cases except in those two villages.

4940. What is the population of the three villages ?—Bellary town has 60,000 inhabitants,— it is the chief town in the district. There is a place called Holligundi with 2,800 inhabitants. Hospet has about 15,000. Those are the three.

4941. Had you any difficulty in carrying out the measures which you have described ?—There was no difficulty. When the people were told that they had to go, we had to assure them that it must be done, and they did not offer any resistance at all.

4942. You had not to overawe them by threatening force ?—Not at all.

4943. We will go to the other two indigenous cases. What are the names of the places ?—Chipagiri and Molagavali.

4944. Take first Chipagiri: what is the population ?—The population is 1,800.

4945. Did you discover how plague was imported into this village ?—I cannot say how it was discovered for certain, but I have a strong suspicion that it came from Guntakal junction. A merchant who was in the habit of coming to this platform to buy kerosine oil, to sell it again, was apparently the first case ; but even that case was a doubtful one because no one saw it. I argue from the fact that the man's house adjoined the house in which our first real patient was found, and that the man died of fever shortly before. He was in the habit of coming to this place. There are a number of assumptions before one can arrive at that conclusion ; but that is my own belief.

4946. But plague was here at that time ?—Yes, it was—it was just after plague was discovered here.

4947. You did not know of this case in time to adopt measures ?—No.

4948. What is the next case ?—The next case was that of the aunt of the same man who came from a place further down the line, called Guti, to condole with the mother of the man who died. She was healthy when she arrived, and developed fever soon after, while staying in the same house.

4949. Did you get early information of that case ?—No, we did not get information of that case either. The third case, which was the first pronounced case, was that of a man who lived in a house at the back of these people—perhaps there was an interval of a few yards between.

4950. Was there any communication ?—I think the man used to buy small articles at the shop of this merchant : he lived with his mother.

4951. You heard of this case ?—Yes. It was treated by an Apothecary who was sent for at once. I myself was at a distance at the time. The Medical Officer went out and saw the corpse, and pronounced it to be most certainly a case of plague.

4952. First with regard to this one which you knew about, you dealt with the house ?—The man had been removed from the house by the villagers.

4953. To where ?—Into a sort of gateway at the entrance to the village.

4954. While alive ?—Yes, while alive. Then from there, while alive, he was moved to a shed outside, a few yards off. These steps I believe were taken at the instance of the people themselves : at all events the doctor saw this case, and having considered it to be one of plague, he set fire to this gateway, and burnt the shed, and disinfected all the people who had been in contact, and segregated them. By that time, I myself went out.

4955. Did you do anything further ?—I got together these few particulars I have given you—the previous history of the case. Meanwhile, the mother of the merchant who was originally attacked died.

4956. In the same house ?—Yes. We could not get her examined because we had no female attendants, or nurses, on the spot. She died very suddenly : there was no opportunity of determining really whether she had plague or not.

There were three people in the merchant's house; and the case at the back makes the fourth case. The mother of the man who was the pronounced case of plague also died.

4957. In the same house?—Yes, in the same house.

4958. There were only two houses infected?—Yes.

4959. Did you take any further steps?—Finding out these facts I thought I would make use of the 100 sepoys that had been placed at my disposal in the previous March. I telegraphed to Bellary for them, and I got them out in about two days' time, and I put a cordon round the village. I also burnt down the house of the merchant. There were no further attacks for ten days. I was about to send them all back again, when there were fresh cases of plague.

4960. In what locality?—In a house quite close—a large house, a very dirty house belonging to cultivators. They had several cattle living inside with them.

4961. Did several cases occur in this third house?—Four or five.

4962. You had information of those cases?—The Sanitary Commissioner and myself discovered two or three of the cases. We went to look at the house, and we found these people all huddled up with fever in the verandah.

4963. Were there any further cases?—There was the case of a servant of these cultivators, who was living in a different part of the village, though not very far off, who was attacked, evidently from having been in contact with them.

4964. That extended the plague into a different part of the village?—Yes. By that time I had determined to evacuate several of the houses round this infected focus. The best plan, I find, is to go up on to the roof, and to take a convenient circle around the actual infected houses, and to order the evacuation of all the houses that fall within the circle. That is what I did in this case.

4965. How many people were there?—One hundred and fifty people were evacuated.

4966. Where did you remove them?—We removed them into a health camp. We gave them some tents, and also a few sheds.

4967. Did you evacuate any further?—Not after that: only those 150. All this time there were a number of persons in contact with those cases, who were under observation in the segregation camp. They were separate, of course.

4968. There would accordingly remain in the village how many persons?—A certain number of the people had scattered: I suppose there would be from 1,200 to 1,500 still left.

4969. What was the further progress of the plague in the first place among the evacuated?—They were entirely healthy.

4970. There was no further case up to the present date?—There was one family who gave us some trouble about going out. They had had a large quantity of cotton, and it was difficult for them to move it. They made some little delay, and they were attacked—two of them, the father and the daughter.

4971. They ought to have gone out but they did not?—Yes. They went after all, but they had this large amount of cotton which they did not know what to do with, so they stayed on for two or three days after the prescribed time. Two, out of about six, were attacked, and they died.

4972. That is so far as the inhabitants of the evacuated district were concerned?—They remained quite healthy, with the exception of two, who were not evacuated, and they died.

4973. Will you tell us the history of that part of the town where evacuation was not effected, with regard to plague?—There, too, I think the people were all right. The curious thing was that we had two or three deaths following inoculation. I am not quite sure, in my own mind, what they died of. Whether they were too weak to stand the inoculation, or whether they might have been plague cases or not, I do not know. At the time I did not suspect them to be plague cases at all: but judging by cases I have seen at this other village, and what I have read on the subject since, I feel some doubt on the subject.

4974. With these exceptions—doubtful cases—there was no further plague?—No, there was no further plague, and there has not been up to date.

4975. You made a reference to inoculation?—Yes.

4976. Tell me when you commenced this inoculation?—I am afraid I cannot give you the date—I can say it was about a fortnight after I got out to the village. I think it was before we evacuated the village, or about the same time.

4977. (*Prof. Wright.*)—Who did the inoculations?—Dr. Illingworth.

4978. (*The President.*)—What was the population of the other village you have just mentioned?—Three thousand and two hundred.

4979. What sects?—Almost entirely Hindus.

4980. Did you ascertain how plague was imported into this village?—Well, it is very doubtful. I do not feel at all certain about it. The first case we heard of was that also of a merchant who had been from this village to a place called Guti, in the Anantapur District, to sell cholam grain: and coming back, he passed through the station. They say he alighted to drink water, and eat some parched grain, but I do not suppose that would give him plague. He was provided with a passport, and he was under observation for 7 days out of the 10, when he developed symptoms of plague.

4981. That was the first definite case?—Yes, that was the first definite case. I suspected that there were concealed cases before, because I have since found that as soon as people got fever in this village, they used to remove the person suffering to a distance of 2 or 3 miles from the village, and keep them there, for fear that they should be segregated, or that we should interfere with them.

4982. They adopted voluntary segregation?—Yes. Having seen what went on at Chipagiri, they adopted this plan.

4983. What steps did you take with regard to this case?—We took similar steps to what we took at other places. We isolated the patients, and disinfected, and so forth.

4984. This case occurred at about what time?—This case occurred about the end of October.

4985. And notwithstanding the measures you have taken, did this case produce any further cases of plague?—Yes. I went out to the village about the 4th or 5th of November, and the next day there was a case in a house on the other side of the street to this man's house.

4986. Is it within your knowledge that there was any communication between the people in the two houses?—No. The first case was that of a merchant who had a shop in front of his house, and the persons in the neighbourhood would naturally resort to the shop, and as it is a small street, the people would be in contact.

4987. Did you adopt the same measures with regard to the second case?—Yes.

4988. What is the third case?—The third case did not occur until 10 or 12 days afterwards. That was the case of a Toti, sweeper woman, employed in the Ambulance Staff.

4989. Did she live in a different part of the town?—She was in camp outside the village. She had been attending on patients who had been removed.

4990. What is the next case?—The next case was that of a family living further down this same street where the first attack was.

4991. Was it far away, or quite near?—It was not very far away—30 yards, I should think.

4992. How many houses intervened?—Several houses intervened. I may say that after these two cases I evacuated a small area, and this woman's house was just beyond the evacuated area, which shows that I did not evacuate enough, probably.

4993. That is the fourth case?—Yes.

4994. Did plague extend further in the district?—The fifth case was that of a Brahman beggar, who was found on a verandah of a house—a house out of which the people had gone voluntarily. It was not within the evacuated area. A number of people left the village through fear: this man took his residence on the verandah and was found there with plague.

4995. Had there been plague cases in this house?—Not to our knowledge. It is quite possible that there were fever cases in it.

4996. What was the next case?—The next case was that of the wife of a Head man of a village who occupied a room the window of which looked on to this verandah where the man died.

4997. How near?—Within two or three yards. It was rather high above the verandah, probably 10 yards. It was a rather high room in a large house.

Mr. E. A. Elwin.

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4998. Were there further cases?—There have been a lot of cases since then, chiefly in the fields.

4999. Did you do anything more in the matter of evacuation?—I have done so recently. We did not know anything about these cases in the fields until comparatively recently. When I found that the place was evidently saturated with plague I determined to evacuate the whole of this village, except the Head man's family. The Head man, I may say, lives in a very fine house. It was a very clean place, and I allowed him to remain, in order to get him on our side. All the rest have been turned out.

5000. Is that 3,000 people?—Not quite, as many had left of their own accord—I should say 1,500.

5001. Are they now living in camps?—They would not go into any camp.

5002. Where are they living?—In the fields around about. They put up bamboo mats.

5003. Scattered over a very wide area?—Yes.

5004. Have you any knowledge that plague is extending among these people now?—I think there were five or six attacks yesterday. There have been many attacks. It is a very large area, and one cannot get accurate information. There is no village within six miles of this particular village.

5005. Your measures here do not appear to have been attended with so much success as in the other village?—No.

5006. How do you explain that?—By the fact that the cases must have been concealed at first, and that we did not get proper information.

5007. Have you had much difficulty in effecting this evacuation?—No. The people were rather unwilling to go out—chiefly the people with large stores of grain. There has been no resistance else.

5008. How long did you take to evacuate the 1,500 people?—We gave them three days. They were ordered to be out by last Thursday morning; but when I arrived there at that time I found that a great many had not gone out. I had them up, and told them that they would be prosecuted, and would have to go to jail unless they went. They then went out.

5009. It has actually taken four or five days?—Yes, and no resistance at all was offered. If I had been on the spot the whole time, they would have gone out before. You must show a great deal of promptness, if you want these things done.

5010. Is inoculation practised here?—Yes.

5011. Has there been any mortality among rats. Take the first village?—No, that is the curious part of it. We did not find any dead rats at all.

5012. Or any other animals?—No.

5013. Now tell us with regard to the second village?—With regard to the second village there have been a few, but a very few.

5014. Have you any information that dead rats had been found in any of the houses previously to the occurrence of plague in that house?—No.

5015. (*Mr. Hewett.*)—Did you resort to this measure of evacuating the whole of the village, because you heard of deaths in the fields?—There were deaths occurring here and there in the village. I got information that as soon as people were attacked with fever in the village, their relations moved them into the fields, so that in case they proved to be plague, we might not take any measures against them in the way of segregation.

5016. They were not cases among the people you had already evacuated from the smaller area?—No, I think not. It is very difficult to say, because they refused in that village to go into any camp. They went into their fields. It is difficult to keep any record of their movements.

5017. You can only find out casually whether they took plague?—Yes.

5018. Is there a doctor?—No.

5019. Is there a native doctor?—No, there is not a native doctor.

5020. Your district is liable to infection from two sides: from the Bombay Presidency and from Bangalore?—From Mysore, the Bombay Presidency, and now from part of Hyderabad and Guntakal.

5021. So that you have plague all round you?—Yes.

5022. You have the passport system in full operation, I believe?—Yes.

5023. From the Bombay side, Dharwar, you have a river and a railway?—Yes.

5024. The river at the present time is in flood?—It is going down rapidly.

5025. Can the people cross without a ferry?—They can now.

5026. Up to date, have you found the passport system effective?—We have had this rule on the frontier stations, and I have managed to stop the ferries at most of the places except those guarded by road frontier stations.

5027. How far is plague off on the Dharwar side?—The nearest point is about 5 miles.

5028. Is there much plague there?—Not very much.

5029. Are the villages which are affected in your district on the Bombay side or on this side?—On this side: one is within 5 miles of this place, and another within 10 or 12 miles. The infection has all come from this side.

5030. On this side do you guard the roads?—We have not done anything of that sort. We have what are called "observation circles."

5031. Can you tell me what they are?—The country is divided into tracts of 10 miles, by 10 miles square. There is what we call a Plague Inspector in charge of each circle, and over every four Plague Inspectors we have a Plague Supervisor. These people patrol from village to village, and try and get information of cases of continuous fever, and of the arrival of suspicious strangers. They have also to see that the passport rules are properly carried out.

5032. Can people enter your district without a passport on this side?—They can enter.

5033. And they do so?—Yes, if they are caught, they are prosecuted.

5034. It is quite impossible to make any system of that sort secure?—Quite so, without a line of patrol, you could not possibly do it.

5035. I suppose that it is by avoiding the passport system that some of these people have got in here with plague on this side?—I do not know that. There are only two villages, one of which is within 5 miles of this place.

5036. (*Dr. Ruffer.*)—In the case of the father and daughter getting the plague after being turned out from their house, how long after leaving the house did they get plague?—They were the people who lingered behind, when they ought to have gone out.

5037. Did they get plague in the village?—None of those who actually left, got it. The girl got plague in the village. The father insisted on attending her, and he got it afterwards in attending her in the hospital.

(Witness withdrew.)

CAPTAIN ROBERTSON, I.M.S., recalled and further examined.

Captain Robertson.

17th Dec. 1898.

5038. (*The President.*)—I believe you wish to add something to the evidence you gave the other day?—I was asked certain questions with regard to the spread of plague from Guntakal Junction to Timmencherla and Guntakal. I should now like to give fuller information on the subject.

5039. You wish to tell us about the history of plague in this district?—Plague was first discovered at Guntakal Junction on the 14th of August. Prior to that two suspicious deaths have occurred here. A Muhammadan coolie was found in the Railway Station suffering with fever, and on examination a bubo was discerned and he was at once isolated. How this man contracted the disease is unknown as he had not been out of the Junction. Then a Komati woman was attacked. The next two cases were in the house of a Railway contractor whose sons were seized with choleraic symptoms. The contractor is known to have had frequent communication with Hubli where the disease existed.

5040. (*Prof. Wright.*)—Why do you put these cases with choleraic symptoms down as plague?—They were diagnosed as plague.

5041. On what grounds?—It is in Government orders that they were plague. I was not there at the time.

5042. You are not responsible for the diagnosis?—No.

5043. You do not know who was?—Dr. Chalk and the Collector.

5044. The Collector is not responsible for the diagnosis?—Not for the diagnosis. That is the history as laid down.

5045. Two isolated cases occurred, and then there was a contractor's case. There were two cases of choleraic disease of some sort?—Yes.

5046. (*The President.*)—Will you proceed with your statement?—The fourth case was that of a Railway breaksman from Bangalore. Information was wired to Bangalore and plague was discerned in his house. The next case was adjoining the bazars, about a hundred yards from the contractor's house.

5047. Had they any connection with the previous case?—Not as far as I know. Two people were here attacked of the Komati caste. One of these Komati people again took the disease to a village, Timmencherla, about one mile distant. Four people died in this house at Timmencherla. I personally visited this house and found dead rats and mice in a decomposing state. I may add that six cases occurred in this village before the village authorities informed me. From this time onwards stray cases occurred in an infected block. This block of 80 houses I evacuated and cleaned, the result being that the disease stopped. No cases of plague occurred in the Health Camp, and the village has been free up to date. Outside the infected block six cases have occurred, each was successfully dealt with 'and no spread took place.

5048. (*Prof. Wright.*)—You dealt with the individual houses?—Yes, outside the block. The people in Timmencherla observed the death of rats, and spoke to me about them. The village of Guntakal is two miles distant from Timmencherla. It was infected through a woman who fled from the first house attacked in Timmencherla. She went to Guntakal and died there about two days afterwards. The house where she died was shut up, and no one entered until Colonel King and myself moved in the matter. About three weeks after this woman died, her caste people also began to die, and two of them died before the other villagers were affected.

5049. "Caste people," what is that?—Komati people.

5050. Did they live in the same house?—No, in the house adjoining.

5051. The first of these cases occurred three weeks after?—Yes, three weeks after this woman from Timmencherla went down to Guntakal. In all cases I visited the houses and in nearly every instance I found dead rats.

5052. Was the first house in which the woman died disinfected: you say it was shut up?—It was shut up for three weeks, immediately after she died. The people would not go near her.

5053. (*The President.*)—Was it disinfected?—No; they put a little cow-dung over the place. The people themselves shut it up. We did nothing more than that until I got the house opened.

5054. (*Prof. Wright.*)—Was the house full of effects, or had the effects been carried out?—The effects had been carried out. There was nothing in the house at all.

5055. The effects were probably somewhere among these Komati people?—I do not think any effects had been in the house. I think it was an empty house. This woman went over from Timmencherla, occupied the house, and die in it. I do not think there were any effects worth talking about. She might have had a bed, but nothing more.

5056. Somebody buried her?—I think she was buried.

5057. Did these people get the plague afterwards?—No.

5058. (*Mr. Cumine.*)—Did no one nurse her?—She had one friend, a relation. His bazar was one of the five I showed you this morning.

5059. Did he go to live in it?—Yes.

5060. Was it near his bazar that these other cases occurred following on hers?—Yes, very near his bazar, separated by two or three houses where no plague had been.

5061. When you opened his bazar, did you find dead rats?—No; it was the only bazar where no dead rats were found, but in all the other houses adjoining dead rats were found. Between the interval of the death of this first Komati woman and the others in Guntakal there was a large mortality amongst rats. That was corroborated by the Tahsildar, who specially enquired into the matter.

5062. (*The President.*)—Were there many houses in which dead rats were found and in which plague subsequently developed?—The rats were found round a certain area, not always in the houses. The Tahsildar made enquiries about it.

5063. But when they were found within the houses, was it usual that these houses had plague in them?—I could not tell you. After this the villagers concealed most of their cases, and only the poor gave information. Cases were taken out of the village moribund to the fields. I emptied a block for cleansing purposes, but it was soon obvious that the whole village was infected. Stray cases were cropping up in all directions. I encountered most trouble with Muhammadans, who almost invariably prevented my going near their houses. After a time they compromised matters by evacuating the house for three hours to allow it being cleared, but this was soon found to be ineffectual on a second case occurring after this temporary evacuation.

5064. (*Prof. Wright.*)—Do these refer to only one house?—They left it for three or four hours to allow it being disinfected, white-washed and mercurilised; and then they went back again. The house was cleaned, but the clothes were not disinfected.

5065. (*Mr. Cumine.*)—Does that relate to only one house?—To one house in particular. It occurred in two or three houses. I may mention that after this house was evacuated for three hours, a fresh case occurred three days afterwards. At present the whole village of 800 houses is empty, but a number of deaths are occurring amongst the Muhammadans in the fields. The other classes, mostly ryots, are fairly free of the disease. There has not been a case reported from the fields of Guntakal since the 12th.

5066. At what date did the Muhammadans go out amongst whom so many cases occurred?—Only a fortnight.

5067. Nine days before this cessation of plague?—They had one case after they went out: they have not had any more. They had a case about four days after they went out into the new huts. There have been no more cases since, that is amongst the Muhammadans who have been put into Government huts.

5068. (*The President.*)—I believe you wish to say something with regard to inoculation?—As regards inoculation I am unable to group the population according to age in Timmencherla and Guntakal villages. The total mortality for three months prior to outbreak was 12. The plague mortality for August, September and October was 44, and the deaths from other diseases for the same period was 22. The gross mortality was 66. The classes inoculated at Timmencherla were Komati and ryots. The inoculation among adult females was considerably in excess over that of males. Over 450 inoculations were done in this village, but inoculation was not commenced until one month after the outbreak, and about the same time the infected block was vacated, so that on the whole I cannot give much credit to inoculation in this case. As regards Guntakal village the population was estimated at 5,000. The outbreak occurred about the 9th of October, although I have reason to believe it started about the 2nd. The figures regarding inoculation are as follows:—

	Hindu ryots.	Komati.	Muhammadans.
Inoculated	450	50	...
Uninoculated	4,000	...	300

The total mortality for the three months prior to the outbreak was 29. The mortality up to the 10th of December from plague is 99, and from other diseases during the same period 10. Inoculation in Guntakal was commenced prior to the outbreak, and in this village again the operation amongst adult females was more frequent than amongst males. The well-to-do Komati class were the first to take kindly to the operation and they were the first to suffer from plague: as I stated before the Komati class brought plague into Guntakal. The Muhammadans refused to have anything to do with inoculation, and I am afraid the mortality amongst them was greater than they care to admit. I know of 22 deaths amongst them, but they have had more, as dead bodies have been taken from their quarters during the night and disposed of. Inoculation in this village came to a sudden stop owing to the death of one of the inoculated (a wealthy man) from plague about three weeks after inoculation was first commenced. I have performed about 1,300 operations, and as far as I can judge, two deaths have occurred amongst the inoculated. The first occurred at Timmencherla, a strong wiry man inoculated on the 15th of October. He had no fever for four days after, but was able to move about. He died suddenly on the 19th at 3 A.M. There were two women in his house, both inoculated: they did not suffer.

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I may add that in this case there were plague houses on either side.

5069. Did he die of plague?—I found him dead.

5070. Had he buboes?—He had no buboes. He was known to have walked about 50 yards the previous evening.

5071. What age was he? Had he been a healthy man previously?—He was between 35 and 40: he had not been ill before.

5072. (*Dr. Ruffer.*)—He died about 7 hours after the last person saw him alive?—Yes; about 3 o'clock.

5073. He was well then?—He had a little low fever, but he had been walking about the whole time.

5074. (*The President.*)—What was the next case?—The second case was a woman at Guntakal Junction. She was inoculated on the 9th of October. She was six months pregnant. She had low fever for 14 days after inoculation, and died suddenly one afternoon after having cooked her husband's food. In her house a child died on or about the 8th of the same month from convulsions.

5075. What association do you intend to suggest in this case between plague and convulsions?—I have found two or three cases of plague here amongst young people which were attended by convulsions. Reports came to me of children dying from convulsions. I went and saw the bodies and found them suffering from buboes.

5076. Did you see the body of this child?—No. I did not see the body of this child, but I sent over my Apothecary to see it. It did not strike me that plague would take young people by convulsions. It was only after that that I began to be suspicious.

5077. (*Prof. Wright.*)—Was the woman seen after death?—I saw her after death.

5078. Had she buboes?—No, she had no buboes at all. There was no hardness or anything like that in her groins. I did not personally see her groins but felt them through the cloth, and I felt the axilla.

5079. Have you seen many cases of plague?—I have seen most of the cases.

5080. Have you seen cases go on for fourteen days without developing buboes?—No.

5081. (*Dr. Ruffer.*)—Was there any history of cough?—No, she had been moving about half an hour before she died. She had no fever. Both the man who died on the 19th and the woman who died suddenly have, in my opinion, a suspicion of plague surrounding them. I examined both, but found no buboes. They were both dead when I saw them.

5082. (*Prof. Wright.*)—You say you saw these two cases of death after inoculation. Did you see any other cases in which there were severe symptoms which did not terminate in death: were the symptoms comparatively slight or did you not have an opportunity of observing them after the inoculations?—I had no opportunity of observing them.

5083. Did you hear of any one being seriously ill?—No.

5084. In the cases of people who got plague after inoculation, do you know whether the reaction was severe or not when they were inoculated?—I have seen no evidence as to that.

5085. (*Dr. Ruffer.*)—Have you had other deaths among the inoculated?—The other deaths from plague amongst the inoculated are as follows. The first case was inoculated on the 11th October. He had plague four days.

5086. In that case do you know where the bubo was?—It was a femoral bubo.

5087. Was he inoculated in the left arm?—Yes; he was inoculated in the left arm. The second case was inoculated on the 8th of October. On the 17th he had plague which lasted for ten days. This is a case in Chipagiri. There is some confusion whether it was actually plague or not. The sputum was sent up to M. Haffkine. When I saw the man his temperature was 103. He was suffering from pneumonia and he had a plague look about him, and he was suffering from a femoral bubo.

5088. (*The President.*)—You found pneumonia on examination?—Yes.

5089. Did you find bacilli?—Bacilli were not found alive. M. Haffkine said he had found bacilli not unlike those of plague, but they would not cultivate. I have got his report. The third case was an imported one. The woman was inoculated on the 22nd of October, and five days afterwards she was taken out of the train here with plague. She recovered.

5090. The symptoms were ambiguous?—They were a little ambiguous. She had fever with a temperature of 103. She had a plague look and there was tenderness in the right axilla.

5091. Was there any swelling?—There was no swelling just under the right axilla.

5092. (*Dr. Ruffer.*)—Did she die?—No, she recovered. The child was inoculated on the same day, the 27th, whilst in the camp. It showed signs of plague and died on the 29th,—that was three days after being taken ill.

5093. (*The President.*)—What was the time relationship with the illness of the mother?—A sepoy in the 2nd Madras Lancers came up here with his wife and two children. The mother was found suffering from fever and taken up to camp, and then sent on to the plague camp. Whilst there, the child took plague. They all lived in the same house in Bangalore; the lines in Bangalore were infected with plague. The next case was inoculated on the 15th of October and died on the 19th. This was the Timmencherla case I have already spoken about. The next case was inoculated on the 1st of October. He got plague 21 days afterwards and recovered.

5094. What is the clinical evidence of plague in this case?—Femoral bubo and fever. His sister who lived in the same house contracted plague. She was not inoculated and she died whilst she was in camp with him. The next case was a man who was inoculated on the 7th of October. Plague was diagnosed on the 24th and he died on the 28th. This was a very wealthy man. After this case people would have nothing more to do with inoculation. The next case was a woman who was inoculated on the 13th of October. On the 23rd of October she got plague, and died the same day. The last case I have already spoken about. The woman was inoculated on the 9th of October; she contracted plague on the 24th and she was dead in her house. It was presumably plague. The child had died of convulsions in the same house 15 days before.

5095. Have you any observations to make on the effects of inoculation with the prophylactic fluid?—The first point which occurs to me is that the same symptoms are not produced in each healthy person by a standard dose. (2) That children stand comparatively large doses of the serum without much fever. (3) I do not care to inoculate women well advanced in pregnancy. I can give no reason for this beyond stating the fact that I have seen a few very weak after it. (4) I have not seen any secondary effects such as abscesses in any cases. (5) I know nothing of the clinical aspects, etc., of plague amongst the inoculated.

5096. Have you any observations on mortality among rats?—Regarding rats I may say that prior to the outbreaks at Timmencherla and especially Guntakal, there was considerable mortality amongst rats.

5097. Prior to the first case?—Not prior to the first case, but between the first case that occurred in these villages and those afterwards recognised,—between those two periods; in that interval there was considerable mortality. In Timmencherla parcherry, which was attacked by plague on the 10th instant, a number of dead rats were found before the first case was reported. I may add this first case occurred in a sweeper employed in cleaning villages. He was missed at the muster and was at once sought for. At Kotala, a small village, four miles from Guntakal, three deaths were reported in a house on the 21st of November. These occurred within a few days of each other. The caste of the family excluded them from mixing with other people. The house was burnt down and the floor kiln-burnt. On the 10th of December another death took place and the body was burnt before I heard of the death. The villagers stated that the man died of hæmorrhagic vomiting. On the 11th of December dead rats were found in six houses, and the people evacuated them. I supplied tents for those people to reside in in a suitable site. Yesterday I was informed by wire of 9 attacks and 3 deaths in that village. This is another instance of an outbreak being preceded by rat mortality. I have noted at the beginning of an outbreak that old people or beggars who sit about the ground are prone to this disease. I have seen I think about six instances, but the real connection I am unable to guess: it may be merely a coincidence.

5098. These are the facts you wish to give us?—Yes.

5099. What is your present system of disinfecting houses?—Up to within a week ago, the first thing done to an infected house was that an opening was made in the roof about 4 feet

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square, and sometimes in the wall of the house. That was found necessary.

5100. You mean if there was not already a hole in the wall?—Yes, or if the house actually required it, being a very dark house. Then the floor and walls were drenched with perchloride of mercury and after they had dried the walls were white-washed. The floor was dug up and burnt in a kiln. About 8 days ago, I received an order to mix the perchloride with the whitewash.

5101. An order from whom?—From the Collector.

5102. (*Prof. Wright.*)—What is lime-wash?—Quick lime.

5103. You add the perchloride solution to the whitewash?—Yes.

5104. Is that for the walls only?—Yes, for the walls only.

5105. For the floors you still adhere to the original plan?—Yes.

5106. Did you make any observation upon that order?—The Plague Commissioner wrote down at once to the Sanitary Commissioner asking how it should be adopted. I did not receive his reply at all, and it has not been communicated to me until this morning. I asked the Sanitary Commissioner about it, and he said he objected to it,—mixing the perchloride with the whitewash.

5107. What is the fate of that order: have you carried it out?—Since this morning I have cancelled the order.

5108. (*The President.*)—It is obviously the case that the perchloride of mercury would be rendered perfectly worthless?—Yes.

5109. (*Mr. Hewett.*)—You said that the first case was a Komati woman: do you know whether she had anything to do with Hubli?—I could not tell you.

5110. Did you ever find out whether the first man had anything to do with Hubli?—He had nothing to do with Hubli. He said he had not been out of the station for three months.

5111. You have not been able to ascertain the cause of the outbreak?—No. There were two people, sweetmeat sellers, who died about the 2nd or 3rd August, but their disease was not recognised. It may have been plague, but it may have not. From a paper in the Deputy Collector's Office on the original outbreak of 2nd August, I am thoroughly convinced that the sweetmeat sellers brought the disease from Hubli.

5112. (*Dr. Ruffer.*)—Is the passport system in vogue? Do the people entering this village have to show their passport?—Not now.

5113. Has it ever been in force?—Yes.

5114. When was it taken off?—After Guntakal village was infected.

5115. So that these cases occurred during the time the passport system was in force?—Yes.

5116. Why did you dig up the floor?—It is an order.

5117. You take no responsibility for that?—It is an order which I have to carry out, that the upper two inches of the floor must be dug up.

5118. You do not know why this order was given?—I simply had to comply with it. I have my own opinion as to it.

5119. (*The President.*)—It is not only a matter of digging up but the material is burnt?—Yes, in every case it is burnt.

(Witness withdrew.)

DR. T. W. ILLINGWORTH recalled and further examined.

Dr. T. W. Illingworth.

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5120. (*The President.*)—There are some points which have arisen with regard to the evidence you gave before us the other day, relating to inoculation, about which we wish to ask you a few questions?—Certainly.

5121. (*Prof. Wright.*)—How many inoculations did you say you had done?—About 1,500.

5122. I asked you whether you know of any deaths having occurred from plague amongst inoculated people, and I believe you answered that question in the negative?—I did.

5123. As a matter of fact there were cases amongst these 1,500 which did die of plague?—No, not of plague, nor from inoculation. Two cases died. One was the case of a nautch-girl. I saw her three or four times after being inoculated. After the reaction set in, she had simple fever, and she died of simple fever a week after the inoculation took place. The other case was that of a man who I should say was over 50. He was not a very strong man and I did not give him the full dose on account of his apparent debility. He died three weeks after inoculation from the same cause,—from fever. They are the only two cases I know of.

5124. Are these the only two cases you have seen? Have you seen severe symptoms after inoculation?—I have seen very severe symptoms in one or two cases in Europeans only. One was a Lieutenant in the Commissariat Department in Bellary. He had an ordinary reaction at first; and on the third day instead of his temperature going down it went up to 105 at night. He was delirious, and the next day he became rather collapsed. I was afraid he was going to peg out. We kept him going on stimulants, however, and he recovered, although he has been rather seedy for some time. I came down to Bangalore before he was out of bed. I hear now, however, that he is getting fairly well. He was delirious and unconscious for hours together.

5125. Had this man any buboes?—Nothing at all but the hyperpyrexia to account for the symptoms.

5126. Was he the only case in which you saw the severe symptoms?—He was a very highly strung nervous man,—a European. Amongst other Europeans I have seen high temperatures and they have complained of sore feelings about the conjunctiva. Their eyes were sore and they could not read. I experienced that myself. I had a feeling of soreness about the eyes for several days myself. Europeans and Eurasians have also complained to me of having headache for ten days, or so, after the symptoms had gone away. I have seen nothing more disastrous than that: certainly nothing serious.

(Witness withdrew.)

ASSISTANT SURGEON WATTS called and examined.

Assistant Surgeon Watts.

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5127. (*The President.*)—I believe you are a retired Senior Military Assistant Surgeon?—Yes.

5128. (*Mr. Hewett.*)—You have been employed here in examining passengers who come by rail?—Yes.

5129. How long have you been employed in that work?—From the 7th of September last.

5130. Can you tell us how many persons you have removed from the train suspected of being ill?—One hundred and eleven.

5131. How many cases of plague developed amongst those?—Four.

5132. Have all these cases been bubonic plague?—All bubonic.

5133. Where did these people who were attacked with plague come from?—Only Bangalore.

5134. None from other directions?—No.

5135. How many died?—Two died and two recovered.

5136. Do you disinfect the clothing of passengers?—That is done in the suspect camp.

5137. Only in the case of people who are taken out of the train and suspected?—That is so.

5138. Nothing is done at the Railway Station?—No.

5139. (*Dr. Ruffer.*)—Where is the suspect camp?—Half a mile from the station. There are two camps, a plague camp and a suspect camp.

5140. What was the total number of passengers examined during that time?—It varies from 10,000 to 15,000 a week.

5141. How do you examine them?—The first and second class passengers are examined in the compartments. The third class passengers are taken out of the carriages and roped off. I examine the men.

5142. How?—I examine their pulse and skin.

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5143. Did you examine them for buboes?—Yes. If I suspected anything from their appearance and their skin, I looked to their necks, axillæ and arms.

5144. Who examined the women?—The Inspectress.

5145. A Lady Doctor?—Yes. She is a diplomaed midwife.

5146. How are the first class and the second class passengers examined?—They are examined in their compartments in the same way as the passengers of the third class.

5147. You simply feel their pulses and their glands?—Yes.

5148. You only examine the glands if you suspect they are ill?—That is so.

5149. Do you put suspected cases into the segregation camp here?—They are first taken here, and if they develop plague they are taken away to the plague camp

(Witness withdrew.)

(Adjourned to Monday, Dec. 19th, at Hyderabad.)

At The Court House, The Residency, Hyderabad.

SIXTEENTH DAY.

Monday, December 19th, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.
MR. C. J. HALLIFAX (*Secretary*).

LIEUTENANT-COLONEL E. A. LAWRIE, I.M.S., called and examined.

Lieutenant-Colonel E. A. Lawrie.

19th Dec. 1898.

5150. (*The President.*)—I believe you are Plague Commissioner for the whole of the Hyderabad Territory?—Yes.

5151. Will you first give us an account of the introduction of plague into your country?—Precautionary measures have been in operation on the railways since the beginning of February 1897. The principle on which these measures are based is to be found in the Resolution of the Bombay Government, No. 5772—5864 P., dated October the 17th, 1898*:—"Plague is conveyed by persons bringing the germ in their bodies or clothing." In accordance with this principle, no persons who are suspected of being likely to bring the germ of plague into Hyderabad either in their bodies or their clothing, have been allowed to enter the city, either by Railway or road. Medical inspections have taken place at Gulbargah, Wadi and Raichur, at which places Observation camps have been maintained. Between Wadi and Lingampalli, the last station of the Nizam's State Railway into Hyderabad, Inspecting Medical Officers have travelled with every train, and if any person has been detected with fever, he has been detained in an Observation camp at Lingampalli, or has been forwarded to a dispensary in the city or suburbs for observation. A temporary bacteriological laboratory was established under the charge of Dr. Mullanah at Gulbargah.

5152. Those are the measures which you recommended in order, if possible, to prevent the importation of plague?—Yes, by railway.

5153. Have you anything to say with regard to general precautions and district work?—Yes. It has always appeared to be natural to destroy plague by fire. In July 1897, I travelled to England in the same steamer with Messrs. Lowson and Reade, the Hongkong Plague Commissioners. Wishing to find out as much as possible of their experience of the disease, I asked them how the infection is spread. They said through floors, and that people got plague from the virus contained in floor dust, and sometimes from recently soiled clothing, as well as from grain which has lain in contact with infected floors. The first cases of plague that occurred in the Nizam's Dominions were three or four which were imported by the railway from Bombay. The bodies, clothing and bedding, and the huts in which all the imported cases were treated, were destroyed by fire, and the disease did not spread. The first indigenous cases of plague which occurred in the Nizam's Territory were reported in December 1897. The disease broke out in villages on the road from Sholapur, leading towards Bidar and Hyderabad, the road followed by refugees from Sholapur, in which plague raged in the latter part of 1896. Orders were at once issued to commence a campaign against plague in the Nizam's Districts on the following plan:—

(1) The districts were placed under the immediate charge of a Deputy Plague Commissioner, Mr. A. H. Stevens.

(2) Troops were placed at his disposal, with a large staff of doctors, dressers and officers, to search out the full extent of the outbreak.

(3) Search parties were despatched along the main roads leading from Hyderabad towards Sholapur, who inspected every one of the villages between the capital and the infected area.

(4) Similar parties were despatched from Gulbargah towards Sholapur with the same object.

(5) A patrolled line was formed extending from the railway across the three roads leading into Hyderabad, for the purpose of detecting and stopping suspicious cases from the infected area.

(6) Arrangements were made to place a double cordon of troops round Hyderabad for the purpose of notifying to the head of the Nizam's Police the names and addresses of all travellers into Hyderabad by road.

The difficulties we had to contend against may be estimated by what happened to the population of Sholapur. The normal population of Sholapur is 75,000. By the end of January, when the outbreak of plague in His Highness's Dominions was little over a month old, the population of Sholapur had dwindled down to 20,000. 55,000 refugees, many of them carrying the infection of plague in their bodies and clothing, had fled into Hyderabad territory. The 55,000 refugees infected every village, British and Nizam's alike, in their line of flight. All the outbreaks of plague that have occurred since have been due to the same cause, *viz.*, importation of the disease by refugees from infected towns and villages in British India.

5154. Did your measures prove unavailing to protect the Hyderabad Territory?—There were no measures adopted with

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* Not printed with the Commission's Proceedings.

Lieutenant-Colonel E. A. Lawrie.

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reference to the Sholapur villages until after the plague had actually broken out in the Nizam's territory. Our first measures were on the railway. So far they have been successful, no cases having been imported into Hyderabad by railway. The measures which we adopted for interception by road were commenced after the plague had begun in these villages near Sholapur.

5155. You adopted measures to stamp out the epidemic? Yes. The measures adopted to stamp out the epidemic consisted in,—

(*a*) Evacuation of the infected villages.

(*b*) Destruction of the infection by burning the floors and walls (surfaces) of infected houses by fire.

(*c*) Disinfection of useless clothing and bedding by burning, and of bedding and clothing generally by boiling.

5156. I believe you proceeded to visit the infected areas?—Yes. On the 22nd of February, arrangements having been completed for the protection of Hyderabad, I proceeded to join the Deputy Plague Commissioner at Ganjoti in the centre of the infected area. The inhabitants of all the infected villages were then in camps, and everything was ready for the systematic disinfection of their houses and clothing. We had yet to justify the selection of fire and water as disinfecting agents by demonstrating the presence of the infection of plague in the floors and clothing of plague-stricken houses and people. On the 25th of February, a chain bacillus, identical in appearance with Yersin's photo-micrograph, was found in scrapings from the floor of an infected house in the village of Sirsi, and disinfection by fire was accordingly commenced that day. The houses in which the bacillus was found were burnt down and the villagers we compensated on the spot, the price paid for the houses being determined by a punchayat of themselves. The following fortnight was spent in the camp of the Deputy Plague Commissioner at Ganjoti. All the infected villages were visited, and a great number of floors were examined and found to contain the same form of bacillus as had been discovered at Sirsi. The bacillus was found in the floors of many houses in which no deaths from plague had occurred. On enquiry it appeared that many houses besides those in which plague patients had died were infected owing to the custom among the villagers of carrying patients sick with plague about on short visits from one friend's house to another until they died. On the 6th of March rats were inoculated with floor scrapings in which the bacillus was found, and died with all the symptoms of plague, and the same bacillus was discovered in their glands and blood. The justification of disinfection of floors by fire appeared to be complete, and our observation showed the disinfection to be so widely spread that we arrived at the conclusion that all the houses in the infected village must be treated in the same way.

5157. To what depth?—About 2 inches. It is fully described in Mr. Stevens's memorandum on the kiln method.

5158. (*Prof. Wright*).—Have we got this memorandum?—It is in the Yellow Book—"Plague—Hyderabad State."*

5159. (*The President.*)—Will you continue your statement?—During the time we were occupied in examinations of the floors, Mr. Stevens was engaged in perfecting the method of disinfection by fire. For several days kerosine oil was used, mixed with straw, dried cow-dung, etc. Many accidental conflagrations attended these trials. At last on the 7th of March 1898, the Deputy Plague Commissioner introduced the kiln method of burning the floors, and this ended all our difficulties. This plan has been in operation ever since and will be described by the Deputy Plague Commissioner himself. The proved advantages of disinfection by the kiln method of burning the floor surfaces, and of burning and boiling infected bedding and clothing, are:—

1. It destroys the infection of the disease.
2. It costs Government nothing, except for supervision. The people willingly employed it themselves under our trained agents and workers.
3. It is popular with the villagers and ryots.
4. It not only destroys infection, but it also destroys the food the plague microbe likes, and by which it is kept alive and toxic.

Under this system the people remain in their camps, and carry out the disinfection of their houses and property, when they are told. There is no scattering, or at any rate a minimum of scattering, of infected refugees to spread the disease all over the country. This is not only true of the Naldrug area, but also of epidemics in places widely separated from the Naldrug District, *e.g.*, Kopbal, Ahmednagar and Lingsagur. After leaving Ganjoti, I proceeded to Bombay, in order to verify the observations on the plague bacillus. In Bombay appearances precisely similar to those found in infected houses in the Nizam's Districts were found in floor scrapings at the Modykhana and Arthur Road Hospitals. Our observations were very instructive. Two pavilions had recently been burnt down, one had been reoccupied, the other had not. In the latter no organisms had been found in the floor. In the former the floor was free from all organisms, but in one place where an old man had lain for several days on the ground beside the cot of his sick grand-child, and had then contracted plague and died, the plague germ was discovered by Dr. Bernard and myself. Dr. Bernard was the Medical Officer in charge of the hospital: he was a Naval Surgeon. A rat was inoculated with the solution made from this floor's scrapings. It died with symptoms of plague, and the same bacillus was found in its tissues and organs. Several houses in Bombay in the infected quarter were examined, and we made some interesting experiments with Dr. Weir. After prolonged drenching with water and disinfectants of badly infected floors, with a strong fire hose, the microbe of plague could still be found, whereas it was not found, nor is any trace of it ever found, in the ashes of the floor scrapings destroyed by fire. During our stay in Bombay we endeavoured to have cultures made from floor scrapings from infected houses, but the fees demanded for the service were prohibitive. I think I ought to explain to the Commission that we did not ask any of the Medical Officers in Bombay to help us: I thought they would all be a good deal too busy. We asked a medical man who had been sent out from England on plague duty, and I may tell the Commission at once (there is no secret about it) that the fee he demanded for making cultures for us was Rs. 200 for each culture: so that we could not have anything done. We also visited M. Haffkine's laboratory, and arrangements were made to introduce his method of prophylactic inoculation into the Nizam's infected villages as soon as possible. After my return to Hyderabad, I made proposals on the 31st of November 1898 to this effect to His Highness' Government, in a letter which I put in as evidence. The letter is as follows:—

"No. 844, dated (Hyderabad Residency), 31st March 1898.

"From—Surgn.-Lieut.-Colonel E. Lawrie, M.B.,
Plague Commissioner, Hyderabad (Deccan).

"To—Mahomed Aziz Mirza, Esq., B.A.,
Secretary to Government, etc., Hyderabad.

"I have the honor to submit the following proposals regarding the introduction of Dr. Haffkine's prophylactic inoculations in the plague-stricken districts of His Highness the Nizam's Dominions for the sanction of Government.

"(2) The objects of the prophylactic inoculations are to diminish the risk:—

(1) of infection by, and

(2) of death in the event of an attack of plague.

"It cannot be proved that these objects are actually attained by the employment of inoculations, but the results of Dr. Haffkine's work at Baroda and elsewhere are so encouraging that there is no doubt that even if they fall somewhat short of this ideal, inoculation does confer a large amount of immunity from the effects of plague. It does not appear, therefore, that it would be right on the part of His Highness' Government to withhold from the people in the infected areas the benefit of a plan of treatment whereby there is a reasonable probability that their sufferings may be diminished. On the other hand, the introduction of a method of treatment to which the people are not habituated may give rise to unfounded alarm if it is not done with great caution and circumspection.

"(3) To prevent the smallest semblance of the employment of *force majeure*, or the possibility of provoking unfounded alarm, it is desirable that the inoculation should be carried out, in the first instance, at all events, entirely by native agency. The two gentlemen who have been trained in Dr. Haffkine's laboratory, Dr. Mullanah and Mr. Syed Mahomed, one a Muhammadan and the other a Hindu, may well be relied on, not only to do the work properly, but also

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* See Appendix No. XVIII in this Volume.

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with such tact as will command the confidence of the people. Their work could be carried out with the co-operation and assistance of Mr. Stevens, to whom the villagers are thoroughly accustomed; and only those persons will be inoculated who themselves desire to submit to it after the process has been thoroughly explained to them. Granted that inoculation is a beneficial process, the object of Government in introducing it is two-fold. In the first instance, its benefits must be made available for the entire population of the infected areas: and in the second place a reliable comparison must be instituted between the effects of inoculation and of no inoculation on a large number of people exposed to plague infection under as nearly as possible similar conditions.

"(4) I would propose that Mr. Stevens be requested to select two villages of as nearly as possible the same size and conditions. A punchayat should be convened in each of the selected villages to whom the precise object of the preventive inoculation should be explained. The punchayat should then put it to the inhabitants of each of the villages to decide whether or not they desire to avail themselves of the additional security against the infection of plague which is afforded by the preventive inoculation. In case of one or both villages agreeing to be inoculated the plan of campaign could then be elaborated. In the former case, one village deciding for inoculation and the other against, a comparison would be easy. If, on the other hand, both villages decided in favour of inoculation, half the population of each should be inoculated and the results in the two inoculated halves compared with the results in the two uninoculated halves.

"(5) The inhabitants of all the infected villages in the Nizam's Dominions are now in camps round about the villages, and they are naturally excessively anxious to know when they will be allowed to reoccupy their houses. It would be an inducement of the most attractive possible kind to intimate to all the villagers that those who protect themselves by inoculation will be allowed to return to their houses at an earlier date than those who do not.

"(6) I feel confident that if once the plague-stricken inhabitants of the villages understand that the Nizam's Government only desire to help them to avoid or minimize the dangers of plague, inoculation will become as popular with them as disinfection by fire is, and I hope that you will obtain the orders of Government in favour of the above proposals as early as possible."

5160. Were you able to make these experiments?—No; but I will explain why in a moment. While these proposals were under consideration, the Director General of the Indian Medical Service visited Hyderabad. The Director General had been inoculated three days previously by M. Haffkine, and he was suffering from fever and erythema due, in my opinion, to septic blood-poisoning. He was laid up all the time he stayed here, (two days) and, as a consequence, which requires no explanation, my proposals fell to the ground. During April and May, it was thought that the plague had died down in the Naldrug area, but on the 13th of May, a fresh outbreak was reported at Aland and Alunga, two villages in the jagir of the Nizam's Prime Minister. In consequence of this outbreak, the temporary laboratory which had been established at Gulbargah, was transferred to Hyderabad, and, on the 1st of June, experiments on animals were made with a view to verify finally the conclusions that have been arrived at regarding the presence of the plague microbe in infected floors. The results of these experiments are recorded in the Yellow Book.* They proved that the plague bacillus can be separated from the dust of floors in plague-infected houses. These results have been confirmed by Dr. Leumann, who has also succeeded in separating plague microbes from the floors of houses infected by plague. On the conclusion of the first series of experiments a second series was commenced, and is still going on, in order to test the effect of prophylactic inoculation. I put in a resumé of these experiments.*

5161. Were these experiments done in your own laboratory?—Yes. They appear to prove that inoculation with small doses of Haffkine's fluid has little or no protective effect against subsequent inoculation with plague. In very large doses it produces fever and blood-poisoning which, in two cases, proved fatal, and in others caused abscesses,—ulcerations. The effects of large doses of the fluid in rabbits afford very considerable protection against plague. An examination of Haffkine's fluid shows that it is not a serum or a vaccine, but a putrescent organic liquid. It contains large numbers of the micrococci of putrefaction, and occasionally it has been found to contain pathogenic organisms. Seeing that the one aim and object of modern medicine and of antiseptic surgery is to keep micrococci and allied organisms, out of the human body, and especially out of wounds, it appears to be directly at variance with correct surgical principles to inject any fluid containing them into the blood and tissues of healthy men. Nothing would induce me, since I have seen what it contains, to undergo inoculation with Haffkine's fluid, nor could I conscientiously recommend it to my patients, European or Indian. I have never performed operations on any class of patients without their express consent, and I do not consider it right to perform such an operation as inoculation with a fluid containing putrid organisms unless the patient clearly understanding its nature, consents or requests to have it done. On the other hand, what is practically compulsory inoculation leads to the spread of plague, by causing people to fly from their homes; and on every ground, it is not to be compared, for a moment, as a method of combating the disease, with the destruction of the infection of plague by fire.

5162. (*Dr. Ruffer.*)—Could you tell us the number of patients who were stopped by examination of railway passengers?—I cannot tell without reference to the records.

5163. Perhaps you could give us that to-morrow?—I am afraid I shall have to send to Wadi for that (see below question 5789).

5164. Does your identification of the microbe found in earth rest on two things,—firstly the morphological characteristics of the microbe, and, secondly, on the fact that when it is introduced into animals it produces plague?—Yes.

5165. With regard to the morphological characteristics of the microbe, in the Yellow Book,* the data which you give are perhaps not as full as one would like to see them. For instance, how does this microbe grow on gelatine?—Dr. Mullanah will tell you details of that kind. All the cultivations were carried out by him. I put him to do it on purpose.

5166. (*Prof. Wright.*)—Are we to take it that you accepted the bacteriological evidence of others, and that that evidence has not come personally under your notice?—The cultivations were all done by him, and all the microscopical examinations were verified by myself. The cultivations were entirely in his hands.

5167. (*Dr. Ruffer.*)—As to the question of the disease produced in animals, in the resumé, you put in the following account:—"Its effects on animals are that in every instance, except those to be hereafter specified, its inoculation causes death with the usual symptoms and *post-mortem* appearances of plague. Inoculation was invariably followed by high fever, and death in from six hours to five days. In all the animals the superficial glands were congested and hæmorrhagic; in others the retro-peritoneal tissues; in others the spleen and liver; and in others the lungs. Wherever the organs appeared to be most severely affected by the poison there the bacillus was found in the greatest numbers."† I do not think I need read the rest?—Full notes are kept of all these experiments.

5168. What I wanted to ask you was this: you describe here the general *post-mortem* appearances of ordinary acute septicæmia; but for myself I do not see any difference between these appearances and the appearances of any acute septicæmia produced in a rabbit by all sorts of microbes?—Plague microbes are found in plague cases and never in other forms of septicæmia.

5169. Do you see any difference, except the presence of what you take to be microbes? Is there any difference in animals between the *post-mortem* appearance in plague and ordinary acute septicæmia?—I should not expect to find any particular affection of the glands in ordinary septicæmia, or any marked appearances in a vast number of cases. Whenever we state that a death took place from plague, we mean that the plague microbe was actually found. If we do not find it we record it as a doubtful death or death from something else. That is taking the whole of the two series of experiments.

5170. I understand that bacteriological evidence is coming before us from another source?—Yes.

5171. (*Prof. Wright*).—First on a matter of principle. You say that the particular bacillus found was plague, there was some bacteriological evidence for that. Are you making yourself the judge of that evidence, or are you judging simply from reports of the bacteriologist? The responsibility must rest with somebody, either with you or with the other bacteriologist who is coming before us,—or else it is divided between you?—Am I responsible for the assertions, do you mean?

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* See Appendix No. XVIII in this Volume.

† Para. 8 of letter No. 2156 of 1898 from Lieut.-Col. Lawrie to the Secretary to His Highness the Nizam's Government, in Appendix XVIII in this volume.

5172. You must be bound by the bacteriologist, or you must take the responsibility?—I think in nearly every case I satisfied myself by examination that the bacillus was the bacillus of plague.

5173. Perhaps the matter will appear more plainly if I take you to a concrete example. You find bacteria in the earth, you take and put them into rabbits, and the rabbits die. Now, on the earth you may find pneumococci: they are present in the saliva of every man, and may be present in his sputum on the floor. The sputum of an ordinary man put into rabbits will give them septicæmia, and they will die of it?—Yes.

5174. In view of this fact I want to know whether the possibility that the bacillus you found was the pneumococcus was considered?—Wherever we found organisms of a different kind, we mentioned them in all the experiments and in all the examinations.

5175. When you found the bacillus which is in question in the rabbit, by what characteristic did you recognize it to be the plague bacillus? There are many septic organisms in the earth which would kill a rabbit?—Yes.

5176. How did you know that the particular micro-organism was the plague bacillus?—It was always cultivated.

5177. What characters in the cultivation told you it is plague? If I provide you with a tube and ask you to tell me whether it is plague or not, what procedure would you adopt?—It was examined in the culture; afterwards it was examined microscopically, and then inoculated into other rabbits.

5178. What were the characters which you noticed in the culture?—You had better examine the bacteriologist as to the exact characters of the cultures. I did not pay particular attention to that. I would not like to make myself responsible for that.

5179. As far as I understand, you must disclaim responsibility for experiments that were done by somebody else?—In that one particular.

5180. That is the essential part of the thing. We ought to have the evidence for the conclusion submitted to us in each individual case.—All these cultures were examined under the microscope, and on the microscopic characters seen by myself I certified practically that they were plague bacilli. I was satisfied with the bacteriologist's *post-mortem* examination.

5181. (*Dr. Ruffer.*)—I understand that we are to get evidence as to the characteristics of these plague cultures from the bacteriologist?—You will get it from two bacteriologists who did the experiments.

5182. (*Prof. Wright.*)—The responsibility does not rest with you, except in so far as you have satisfied yourself that a competent bacteriologist was entrusted with the differential determination?—I exercised a general supervision over the whole of the experiments.

5183. I understand you to say that after burning, you can find no micro-organisms in the ashes?—That is so.

5184. And after you put antiseptics on do you find micro-organisms in the soil?—We did,—frequently.

5185. Do you think the fact that you can see micro-organisms proves there is still infection in the soil?—It was a proof that either there was still infection in the soil, or that the food of the infection was there: or we could say that these were the appearances that corresponded with the appearances we were accustomed to find in plague infected soil.

5186. In soil which has been disinfected by fire you find no bacteria? You have no doubt whatever that ashes cannot be infective?—The ashes cannot be infected.

5187. In soil which has been disinfected by pouring on sublimate, or carbolic acid, or any other antiseptic you can by the microscope find bacteria?—Yes, we have found bacteria under these conditions.

5188. Do you take it if you can see bacteria that the soil is necessarily infective?—I should say that the soil still required disinfection.

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5189. Might the bacteria which you see in such a case not be dead bacteria?—They might, but I should not like to give an opinion as to that. I should say generally that if we found bacteria still in the soil we were supposed to have disinfected, it would require further disinfection.

5190. I do not understand that. Supposing this room were filled with mosquitoes, do you still think that they could do any harm after they had been poisoned?—I do not say that. I say you could not tell whether bacilli were alive or dead by mere microscopic examination.

5191. If you examine with a microscope and find bacteria there, you then conclude that the earth is probably infective?—Probably. We do not make that final.

5192. (*The President.*)—Did you take any steps to discover whether they were living bacteria?—In our temporary laboratory in Hyderabad we have always made cultivations, but this happened in Bombay, and no further steps could be taken there to find whether the bacteria in the soil were alive or dead. We examined the floors, and found bacteria in them; we had a hose turned on, and we still found them, but in much fewer numbers; therefore we said that the disinfection was not complete. That is only a rough statement.

5193. (*Prof. Wright.*)—If the bacteria are not all washed away by the antiseptic do you conclude that there has not been a sufficient disinfection?—That is a matter of opinion.

5194. Can there be a difference of opinion with regard to that? If you see a lion dead, is he still dangerous to life?—I might not be able to certify if the bacteria were alive or dead. Most of the preparations were made by staining, and of course after staining they were dead.

5195. That is not a proper way of finding out whether the earth was sterilised or not?—We do not say it was final.

5196. The point is, ought any importance whatever to be laid upon the fact that bacteria can still be seen under the microscope?—I think very considerably. It would have considerable weight with me if I was disinfecting a house, and I still found the same appearance of the soil as I found before the disinfection.

5197. You say that in Haffkine's fluid you could not determine whether the bacteria were dead or alive by looking under the microscope?—The mere fact of finding bacteria in Haffkine's fluid made me suspicious.

5198. If you took these bacteria and boiled them, and you were still able to see them, would you conclude that they were still living because you could still see them?—Not because I could see them. I said if I was not absolutely certain that they were dead I should be extremely suspicious about it.

5199. Why do you sterilise only the surface of the ground of the house: why do you not sterilise the walls?—We made examinations of the walls, but we never found bacteria in the wall-scrapings.

5200. Why did you not sterilise the roof; the rats are in the roof?—I have visited all the villages in the infected area of Naldrug, and I have had no evidence that rats were in the roofs nor did I ever see any rats at all. As a matter of fact, we tried to-day to get rats in the village, but we could not get any without very great difficulty.

5201. You said you found that Haffkine's fluid conferred very great immunity on rabbits when applied in large doses?—Yes.

5202. And that small doses gave very inefficient protection?—There was no protection at all in three cases in which small doses were used.

5203. You infer from that, that you ought to give just as large doses in proportion to man as you do to rabbits?—I infer nothing of the sort, but I should not dare to experiment with such large doses in man. Those doses were only used for the purpose of experiment in order to get to the extreme dose for rabbits.

5204. Do you think that your experiments discredit Haffkine's treatment? Do you infer from the experiments on rabbits that a small dose does not protect a man?—I do not infer anything. A small dose does not protect rabbits.

5205. (*Dr. Ruffer.*)—I take it that we shall have further bacteriological evidence upon Haffkine's fluid?—Yes. An

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examination was made under Dr. Wright's orders yesterday by Dr. Johnston in the laboratory, up to a certain point. That is to be put in as evidence, I believe. We are perfectly willing that anybody should examine the bottles we have got if he wishes. Our examinations have been pretty numerous.

5206. (*Prof. Wright.*)—Perhaps, Dr. Lawrie, you will come up again?—I shall be most happy.

(Witness withdrew.)

MR. G. MULLANNAH, called and examined.

Mr. G. Mullannah.

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5207. (*The President.*)—You are a Bachelor of Medicine I believe?—Yes.

5208. What is your position here?—Bacteriologist.

5209. Attached to the School of Medicine at Hyderabad?—Yes, as a lecturer.

5210. I understand that you personally conducted a large number of bacteriological experiments in connection with the plague bacillus?—Yes.

5211. (*Dr. Ruffer*).—I believe this is a copy of the experiments you put forward in evidence: "Experiments in the Temporary Laboratory, Hyderabad Medical School"*?—Yes.

5212. It was put in by Dr. Lawrie also?—Yes.

5213. In your first experiment you say "Rabbit No. I Inoculation Experiment with scrapings from the floor of an infected house. No. 1 was inoculated with 5 c. c. of a watery solution of scrapings taken from the floor of the house of Hunia, dyer." I suppose that was a house infected with plague?—Yes.

5214. The animal died on the next day, the 16th of June?—Yes.

5215. Would you tell the Commission on what evidence you based your diagnosis that this animal had died of plague?—On the morphological evidence.

5216. Have you any idea at what hour that animal died?—It died the next morning.

5217. Did you see it between the time of the inoculation and the time of death?—Yes.

5218. Kindly give us an account of the temperature during that time?—I have not got the temperature chart here, but will send for the books.

5219. What were the symptoms in that animal?—A rise of temperature: that was the only symptom which was observable in the animal beyond the refusal of food and dullness.

5220. Did the animal die in the morning?—The animal died in the morning.

5221. You made a *post-mortem* examination, what did you find?—Germs were found in the blood, spleen and glands.

5222. Were the glands enlarged?—Yes, and hæmorrhagic.

5223. Where was the animal inoculated?—In the peritoneal cavity.

5224. What glands did you find enlarged?—The retro-peritoneal glands.

5225. Did you make cultures from this rabbit?—Yes.

5226. From what organs did you make the cultures in the first instance?—Blood, spleen and glands.

5227. What did you find?—We found minute colonies in the agar; and when that grew in broth it was clear; the organisms grew in little specks adhering to the surface and bottom, and all the broth was clear. Then after several experiments, we tried inoculating those germs in a big flask containing broth with a little ghee on the top and we found stalactitic growths as described by Haffkine.

5228. Will you describe them?—There were fine processes of growth like the roots of a banian tree shooting from the surface of the ghee.

5229. How long did the stalactitic growth take to show itself?—A week or two.

5230. At what temperature was this grown?—It was ordinary room temperature.

5231. Did you grow the microbes in gelatine?—No.

5232. Have you grown it in gelatine since?—I have grown plague germs in gelatine in Berlin, but not in India as the temperature here liquefies the gelatine. I used agar.

5233. You have no knowledge of how it grows in gelatine?—Yes, I have.

5234. How does it grow?—It does not liquefy the gelatine.

5235. How does it grow: does it spread to the sides, or spread downwards, or grow on the surface? What are its characteristics in gelatine?—I made streak cultures on the surface of the gelatine.

5236. What were the characteristics of that streak culture?—It was just like agar, the only difference being that it does not liquefy the gelatine.

5237. Does it grow in acid or alkaline bouillon?—It grows in slightly alkaline bouillon, and sometimes in very slightly acid bouillon—very slight.

5238. Under the microscope, what were the morphological characteristics of that microbe?—It was bi-polar-stained. It was unstainable by Gram's method.

5239. Was it motile?—Very slightly motile,—does not move across the field.

5240. Did you try to demonstrate cilia?—No, I did not.

5241. Had it got a capsule?—I did not succeed in getting a capsule.

5242. Did it form chains?—Yes, in broth.

5243. Have you any other morphological evidence as to the identity of this bacillus with plague bacillus?—Yes, peculiar involution forms which it takes when grown in agar containing a certain percentage of common salt.

5244. Are you aware of any other micro-organism presenting the same morphological characteristics as this plague bacillus?—The pneumonia bacillus in some points.

5245. Any others?—There is the bacillus described by Dr. Lund in chronic bronchitis.

5246. Is not the bacillus of fowl cholera something like it?—Yes.

5247. What is the morphological difference between the bacillus you found and these other bacilli, the bacillus of fowl cholera for instance?—They resemble one another.

5248. I take it there are no morphological differences?—It is very difficult to say.

5249. How do you differentiate your bacillus from the bacillus of fowl cholera?—From its characteristic growth in broth, stalactitic growth in broth containing ghee, invisible growth on potato, its involution forms, does not produce enteritis in rabbits as a rule, fowls and pigeons do not suffer in any way when inoculated with it.

5250. Have you tried whether the bacillus of fowl cholera does that?—No. Other observers have found this to be the characteristic growth.

5251. I believe this growth on ghee is quite a new method: are you aware whether other observers have tried to get it with fowl cholera?—No.

5252. How can you say that there are marked morphological differences between your bacillus and any other bi-polar bacillus? You say you diagnosed this bacillus from its mode of growth on media, and by its morphological differences: I want to know exactly in what way you could differentiate this bacillus from any other bacillus which stains at both ends?—By Gram solution.

5253. Does the bacillus of fowl cholera stain with Gram?—I do not know.

5254. Did you try and immunise animals with your bacillus?—Not with that bacillus.

5255. You did not try to immunise animals with your bacillus against plague bacillus cultivated from an authentic plague patient?—We did not do that.

5256. Did you try whether you could obtain Widal's test for this bacillus?—Yes.

5257. With serum from a plague patient?—Not from a plague patient, but animals protected with Haffkine's fluid and we got Widal's test.

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* See Appendix No. XVIII in this Volume.

5258. How did you do that?—I took a certain amount of blood from rabbits which were protected with Haffkine's fluid, and diluted with sterilised broth in the proportion of 1 to 13; then took a loop-full of plague culture, mixed thoroughly with broth,—about 5 c.c.—and on examining the emulsion I found the organisms were quite separate,—isolated; and then I used one drop of this and one drop of the diluted serum, and applied Widal's test under the microscope.

5259. What did you find?—I found organisms in clumps. I made also a control experiment with serum of a healthy rabbit not immunised and found negative results.

5260. Now we come to rabbit No. 2. "Rabbit No. 2, control experiment. No. 2 was inoculated in the peritoneum with drachm-doses of putrid urine on the 11th, 14th, 15th and 16th of June 1898, and remained well." How is this a "control experiment" of No. 1?— Just to see whether any putrid stuff will cause the same symptoms.

5261. Surely putrid urine cannot be compared with putrid earth: they are two absolutely different things?—Both are putrid.

5262. Both are putrid certainly, but I do not see how No. 2 is a control experiment of No. 1. The two experiments are absolutely different. Every condition in the experiment is different. In the first experiment you inoculated with 5 c.c. of a watery solution of scrapings taken from the floor of a house, and in the second experiment you inoculated in the peritoneum with drachm-doses of putrid urine. What has putrid urine to do with putrid earth?—We did it to see if putrid urine causes any symptoms.

5263. How is this second experiment a control of the first? I can see that it is an experiment, but I do not see how it is possibly a control of the first experiment.—In case the animal dies of septicæmia we wanted to study the organism which produced septicæmia and to see how it differs from plague germ.

5264. In all these experiments which follow afterwards, when you say that the animal died of plague, I suppose we may take it that it died of the same disease as the first?—Yes.

5265. And you assume that the two microbes were the same?—Yes.

5266. With regard to rabbits No. 6 and No. 7, you say—"Inoculation experiment with a culture of the plague microbe. No. 6 was inoculated on the 26th of June 1898 with 1 c.c. of an agar culture liquefied from the blood of No. 4. Died on the 29th of June of plague. Control experiment. No. 7 was inoculated in the peritoneum with two drachms of sterile pus from a liver abscess on the 30th of June 1898, and remained well." Are not the conditions of the two experiments different? How can "sterile pus" be described as a "putrid substance"?—Our object was to inoculate pus directly from a liver abscess.

5267. I want to know how these experiments can be described as "controls" of the inoculation experiment with plague culture or the experiment with earth. I find that in your first "control" experiments you inoculated drachm-doses of putrid urine?—Yes.

5268. In the second one you inoculate sterile pus, in the third one, one drachm of sterile broth employed for pure cultures, and in the last one, 0·5 c. c. of putrid blood. These "control" experiments neither agree with one another nor with your original experiments. I want to know how those four experiments can be regarded in any way as "controls" of your other experiments?—To see whether we get septicæmia from these putrid substances, and then to isolate any organism which causes septicæmia, to compare it with plague germs.

5269. You said in your statement "control" experiment. If it is a "control experiment," it is a control of something. I want to know what it is a control of?—Of the first experiment.

5270. How can one drachm of sterile broth be a control of scrapings taken from the floor of an infected house? I do not understand it. Experiment No. 11 is supposed to be a "control" of No. 1. I find that No. 11 was inoculated with one drachm of sterile broth, while No. 1 was inoculated with 5 c. c. of a watery solution of scrapings taken from the floor of the house. I do not see that these two experiments have anything to do with one another?—No. 3 is an inoculation experiment with a plague culture in broth, and No. 11 inoculated with sterile broth as control; to see whether sterile broth causes any symptoms; also done on suggestion.

5271. No. 2 is a "control" experiment. "No. 2 was inoculated in the peritoneum with drachm-doses of putrid urine"?—Yes.

5272. What other experiment is it supposed to control?—It was only to find out whether it caused septicæmia.

5273. (*Prof. Wright*).—Did you do any "control" experiment with ordinary earth which was not infected? You want your control to show that there is nothing in the earth except plague which could have killed the rabbit. You have an experiment to show that the broth did not kill him: have you anything to show that there was nothing else in the earth which killed it? I take it that urine and blood were not present in the other experiments, and therefore they are not "controls"?—We have not had real control experiments with ordinary earth.

5274. (*Dr. Ruffer*).—But the second series has no bearing on series No. 1. The second series, I take it, is done with cultures from a plague patient; but in series No. 1 we deal with experiments with scrapings from the floor of an infected house. Did you ever take scrapings from the floor of a non-infected house, mix it with water, and inject that fluid into an animal?—Not with these experiments, but I have done it repeatedly.

5275. Since?—No, before.

5276. What did you find?—I found that the animals sometimes died of tetanus.

5277. Did they die of anything else?—Malignant œdema or septicæmia.

5278. What organisms did you find in that septicæmia?—Streptococci.

5279. Did you ever find bacilli showing bi-polar staining?—No.

5280. You said that your plague bacillus resembled the pneumo bacillus, did you not?—Yes, in some points.

5281. Is it not a fact that the pneumonia bacillus is very often present in saliva?—Yes.

5282. And is it not a fact that people expectorate on their floors pretty freely?—Yes.

5283. Why is your bacillus not the pneumo-coccus?—There are great differences. First of all, the morphology: the pneumo-coccus is a large bacillus. One can see it at once.

5284. Were the experiments in series No. 2 all done with a culture from a plague patient?—Yes, most of them.

5285. In series No. 2 you inoculated with 3 c. c. of a plague culture?—Yes.

5286. What was the minimum fatal dose that would kill a rabbit?—A loop-full of an agar culture.

5287. Do you inject 3 c.c. of a bouillon culture?—No; of an agar culture mixed in broth. The whole of the agar tube is generally mixed with 4 c.c. of sterile broth, and out of that 1, 2 or 3 c.c. were taken, as required.

5288. Then you injected several loops?—Yes.

5289. How many times?—I think six loop-fulls.

5290. Then you injected six times the fatal dose?—Yes.

5291. Would you expect the 3 c. c. of Haffkine's fluid would protect against six times the fatal dose?—This was only an experiment to see if it did protect or not.

5292. (*Prof. Wright.*)—Did you say that 3 c. c. is equal to six loop-fulls?—No, one whole tube.

5293. (*Dr. Ruffer.*)—You say in your next experiment—"rabbits Nos. 6, 7, and 8, Prophylactic inoculation experiments. Inoculated twice with Haffkine's fluid No. 6 with 6 and 10 c.c., No. 7 with 9 and 15 c. c., and No. 8 with 12 and 20 c.c., on the 16th and 22nd of August 1898. Inoculated with plague, 1 c. c. on the 27th of August; 1 c.c. on the 11th, 1 c. c. 14th, and 3 c. c. on the 29th of September; and 1 c. c. on the 8th of November 1898. All living"?—Yes.

5294. In this case then the fluid had some protective action?—Yes.

5295. No. 9 "Inoculated with 2 c. c. and 20 c. c. of a culture of the organisms from Haffkine's fluid on the 18th and 23rd of August 1898." What were the organisms you found in Haffkine's fluid in the first instance? How did you isolate them?—Brown cocci. By cultivating them.

5296. How?—In agar tubes.

5297. Did you find different kinds of micro-organisms?—Yes.

5298. How many?—In some brews we found brown cocci and in others white.

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5299. Anything else?—Yellow and white pyogenic cocci and sometimes bacilli.

5300. Anything else? Were you able to identify these micro-organisms?—Yes.

5301. What micrococci did you find?—Staphylococcus pyogenes, brown and white cocci.

5302. The staphylococcus pyogenes aureus is the only one you identified?—And albus.

5303. How did you identify them?—When we inoculated healthy animals, they produced abscesses and ulcers.

5304. Did you identify them by culture characteristics? —Yes.

5305. You were satisfied that they were staphylococcus pyogenes aureus and albus?—Yes.

5306. What are the organisms you actually used in experiment No. 9? You say "inoculated with 2 c. c. and 20 c. c. of a culture of the organisms from Haffkine's fluid." Do you mean to say that you cultivated all the micro-organisms together?—The brown coccus.

5307. Rabbit No. 9 refers to that brown coccus and to no other?—That is so.

5308. And you inoculated it with plague on the 22nd of August 1898? You had inoculated it with 20 c. c. of a culture of this brown organism, so that it cannot have been very virulent, can it?—No.

5309. The animal died of plague?—Yes.

5310. Did you expect this coccus to immunise this animal against plague?—No, but I was ordered to do this experiment.

5311. I ask you why you did the experiment: did you expect it would immunise the animal against plague or did you perform the experiment to show this coccus was not the plague bacillus,—was that so?—No.

5312. In the next experiment you inoculated 9 c. c., 15 c. c., 12 c. c., and 20 c. c., respectively, of Haffkine's fluid and as a result there was marked immunity against the plague bacillus. Then rabbits Nos. 12, 13, 14, 15 and 16 were inoculated with 20 c. c. each of a culture of the organisms from Haffkine's fluid: could you tell us what these organisms were?—Rabbits 12, 13 and 14 had brown cocci and rabbits 15 and 16 had white cocci.

5313. What kind,—aureus or albus?—Neither, they were not pyogenic cocci.

5314. Considering you injected 20 c. c. without any obvious effect, it could not have been very virulent?—No.

5315. You say,—"The survivor No. 10 was further inoculated with 3 c. c. of a culture of plague on the 29th of September, and with 1 c. c. on the 8th of November 1898, and is still living": so that that animal showed a certain amount of resistance against plague?—Yes, marked resistance.

5316. You did not find any difference between animals that had been vaccinated from the calf and ordinary animals, "Rabbits Nos. 18, 19, 20 and 21,—Prophylactic vaccination experiments:" did you find that animals vaccinated from the calf had an increased resistance against plague?—No. There were two rabbits which survived the first inoculation but died on second inoculation.

5317. In that case again you used a very large dose, 1 c. c., of plague culture prepared in the same way?—Yes.

5318. That would correspond to 1½ loop-fulls; is that rather a large dose?—Yes; but these cultures might be of different strengths.

5319. In rabbits Nos. 23 and 24, you say,—"Prophylactic experiments with the organisms cultivated from putrefying urine (healthy). Inoculated with 1 c. c. of culture of diplo-bacilli from putrescent urine on the 6th and 7th of September 1898": what were these diplo-bacilli?—I could not say. There was a great difference between these bacilli and plague.

5320. They produced no effect?—No.

5321. Again' rabbit No. 31,—you say,—"Inoculated with (home-made) Haffkine's 'serum',": what do you mean in that case by serum; do you mean his ordinary prophylactic fluid or serum from animals?—Ordinary prophylactic fluid.

5322. "Inoculated with 3 c. c. of a plague culture on the 7th of October 1898." What was the strength of that culture?—It killed that animal.

5323. Did you not do a control at the same time?—Yes with 3 c. c.

5324. You inoculated that animal with 3 c. c.: where is the control to that experiment?—That also had 3 c. c.

5325. You have got a control?—Yes, rabbit No. 49.

5326. Again, in rabbits Nos. 37 and 42, you found no difference between animals vaccinated from the calf and ordinary animals?—No.

5327. In the next paragraph, rabbits Nos. 43 to 48, you say—"No. 46 died from the effects of the last inoculation on the 22nd of October 1898": what did you find at the *post-mortem*?—I must refer to the notes.

5328. Did it die of plague?—No.

5329. Did it die of any form of septicæmia?—It died of peritonitis.

5330. In the next paragraph you say,—"Experiments by inoculation with cultures of earth from the floors of suspected houses in Kotmal": how did you prepare these cultures?—By putting suspected earth into tubes containing sterile broth, and inoculating all the organisms which grew in them.

5331. They did not die—I see a note here "Alive"?—They are alive; they did not die. They got quite well and we used them again.

5332. "Rabbits Nos. 53 to 58. Experiments with watery solutions of floor scrapings from infected houses. All the animals in this batch were inoculated with solutions of water of scrapings from infected houses on the 27th of October 1898. No. 53 died of plague on the 28th of October 1898; No. 54 died of tetanus on the 4th of November 1898; No. 55 is alive; No. 56 is alive; No. 57 died of plague on the 29th October 1898, and No. 58 died of tetanus on the 31st of October 1898." In these experiments is there considerable difference in the effect of the inoculation on different rabbits?—Yes.

5333. So that when you use this method of inoculating animals with earth from a plague-stricken house, the chances of missing the plague bacillus even when present are considerable?—We were not sure whether all of them contained plague germs.

5334. I am only criticising your method. You have here a series Nos. 53 to 58; that is a series of six rabbits. In only two cases out of six did you find your plague bacillus, assuming that it is the plague bacillus?—We were not sure that all the six contained plague; and it is possible that the remaining four did not contain plague germs.

5335. Are we to compare them with one another? Were they made with the same scrapings?—Not with the same scrapings.

5336. How do they differ from one another?—No. 53 was inoculated with floor scrapings from Nagawag's house. No. 54, from that of Itoba's house, No. 55, from Rawji's house, No. 56, from Sudama's house, No. 57, from Rama Dher's house, No. 58, from Ghondi Dher's house.

5337. Why are they put here together in the same paragraph: I do not see how they compare with one another?—These animals were all experimented with suspected floor scrapings, and they were done on the same day; so they are put down here in one paragraph.

5338. In your experiments Nos. 66 to 70 were the animals all inoculated with the same vaccine lymph?—Yes.

5339. In that case, also, there was no protection against plague?—There is one rabbit that is still alive, No. 67.

5340. In your next experiment, Nos. 71 to 79 you say "In the case of 71, this was followed by very severe ulceration at the site of inoculation." How did you inoculate this animal?—Subcutaneously.

5341. How long was it before ulceration showed itself?—Six or seven days afterwards.

5342. I suppose you took antiseptic precautions?—Yes.

5343. You had ulceration in two other cases?—Yes.

5344. "No. 73 died of toxæmia in 7 hours." Would you describe exactly what occurred,—toxæmia is rather a vague term?—I inoculated with 20 c. c. of Haffkine's fluid at about 11 o'clock, and it died about 3 the same afternoon. We made a *post-mortem* examination, but no organisms were found in any organ.

5345. Did you make ærobic and anærobic cultures?—Yes. There was no growth of organisms.

5346. "Rabbits Nos. 80 and 81. Experiments with plague earth. Both these animals were inoculated with 3 c.c. of a watery solution of prepared earth": what does that mean ?—Ordinary floor scrapings from a non-infected place mixed with plague culture in the laboratory.

5347. You added plague culture to the earth? —Yes.

5348. And the rabbit died of plague and tetanus ?—Yes.

5349. I think you found that a sub-culture of plague given by the mouth, or a scratch with the sub-culture of plague, did not kill the animal: the results were uncertain ?—Yes.

5350. The inoculations in the trachea killed the animal?—Yes.

5351. " Rabbits Nos. 89 to 92. Prophylactic experiments with the organisms from Haffkine's fluid. All the animals in this batch were inoculated with 20 c.c. of a sub-culture of the organisms from Haffkine's fluid." What organisms were they ?—Staphylococcus pyogenes aureus.

5352. You injected 20 c.c., without producing any effect ? —It produced a temperature of 3 or 4 degrees, abscesses and ulcers.

5353. You do not say so here ?—It is in the notes.

5354. " Rabbits Nos. 94 and 95. Experiments on young (immune ?) rabbits. The mother of 94 and 95 is No. 48 which was twice inoculated with Haffkine's fluid on the 7th and 21st of October 1898, and with 1 c.c. of a plague culture on the 7th of November 1898. Nos. 94 and 95 were born on the 22nd of November, and were inoculated with a plague culture in a scratch on the thigh on the 7th of December 1898." Are both alive ?—Yes.

5355. Have you tried any other young rabbits ? Do you know whether young rabbits are naturally immune against plague or not ?—No, we have not tried on any other young rabbits.

5356. I do not quite understand the following—" No. 2 :—Plague culture in agar is liquefied by mixing a measured quantity of sterilized broth with it in the tube. The culture mixes evenly with the broth and the agar remains." Do you mean to say you pour broth over the tube and you scrape off the culture ?—Yes.

5357. (*Prof. Wright.*)—Do you agree with Dr Lawrie when he says that you can track plague by means of the microscope with any certainty : can you determine by the microscope whether a house is infected or not ?—I cannot say.

5358. Can you do so or not ?—I do not think one could do it by the microscope alone.

5359. Do you think you can by the inoculation method determine whether a house is infected with plague or not ?—In a certain proportion of cases.

5360. In what proportion of cases do you think you can do it ?—If done on a large scale. I cannot give any definite proportion.

5361. How many rabbits would you use for the purpose ?—A dozen or two.

5362. If you did a dozen or two rabbits and none died of plague, would you pronounce the house to be free from infection ?—Yes.

5363. As a matter of fact how many plague houses have been examined with positive results ?—Four.

5364. How many houses have you examined ?—I have not examined any houses myself.

5365. Earth has been sent to you from four plague houses ?—More than four.

5366. From how many houses have you had earth supplied to you ? Are these all the experiments ?—Yes.

5367. There are six successful in one batch ?—In one batch there are two successful.

5368. In experiments Nos. 53 to 58 there were six houses infected and you found plague in two ?—Yes.

5369. In three houses you got a positive result, and in four houses you got a negative result ?—Yes.

5370. In addition to that have you examined any earth from plague houses ?—Yes.

5371. How many more ?—Several.

5372. Do you know how many more were examined ?—Four or five.

5373. That would give you three positive results, and eight or nine negative results ?—Yes.

5374. In view of that do you think this a practical method of finding plague in houses ?—I think so.

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5375. I think Captain Leumann asserts that he found the plague bacillus only in three out of twenty-five examinations. Further we have had evidence from Dr. Gibson that he has never yet succeeded in finding the plague bacillus in earth in Bombay. Taking all these together do you think this method of inoculating plague from plague houses is a suitable method for determining whether a house is infected or not ?—That is the best we have got.

5376. Yes; but do you think you would withhold disinfection from houses in which you failed by this method to find plague bacilli ?—One cannot be sure of examining earth all over the floor.

5377. I ask you your personal opinion, whether you would withhold disinfection from a house in which you could not find these microbes ?—First of all one cannot examine the whole earth.

5378. Therefore you do not think that this inoculation method is a practically useful method ?—I do not think it is a practical method.

5379. Dr. Lawrie has expressed an opinion that Haffkine's vaccinating prophylactic fluid is largely contaminated ?—Yes.

5380. What experiments have you made upon that matter ?—Cultivation and isolation of organisms and their inoculation experiments on animals.

5381. How many experiments is this your opinion based upon ? Will you tell us how your experiments were made ?—All the experiments in the Second Series, where rabbits were inoculated with Haffkine's fluid.

5382. What method did you employ to determine whether this vaccine material was contaminated or not ?—Examining the hanging drop without staining, besides the above.

5383. How many of M. Haffkine's bottles have you examined by the hanging drop method ?—All the bottles used.

5384. I have not had an opportunity of learning how many bottles you have used. Can you tell us how many bottles were tested ?—I think there were about two dozen experiments.

5385. How did you choose the bottles : were they all chosen from one brew, or did you take them at random ?—We used to take them from different brews and at random.

5386. Were the bottles securely sealed ?—Yes.

5387. In those twenty-four experiments, how many negative results did you get ?—In all the twenty-four bottles we got organisms.

5388. What kind of micro-organisms did you see ? Did you see motile organisms in all the twenty-four ?—Micro-cocci and bacilli, some motile.

5389. Do you think you could judge whether the fluid was contaminated or not by looking at it in that way under the microscope ?—We cannot be sure : we always cultivated them.

5390. Then your hanging drop method of testing is not a very sound one : what other method did you employ ?—Cultivation.

5391. How many cultivations did you make ?—We succeeded in all of them.

5392. You mean in the case of all those twenty-four bottles ?—Yes.

5393. Those bottles were well-sealed up bottles ?—Yes.

5394. Did you ever find plague bacilli in the vaccine ?—No, we never succeeded in finding plague.

5395. You found certain other micro-organisms in the bottles of vaccine ?—Yes.

5396. You determined that with Haffkine's fluid you did get protection against plague ?—Yes.

5397. Did you determine whether the other organisms present gave you protection against other diseases, septic infection ?—We did not try other diseases.

5398. When you found these micro-organisms in the vaccine was it your opinion that the fluid ought not to be used for vaccination in man ?—Yes, it spoils the prophylactic power.

5399. You found that the vaccine had prophylactic power in rabbits in spite of the fact that it contained foreign micro-organisms ?—Yes.

5400. Why do you say that these micro-organisms spoil the prophylactic power : were you afraid the potency of the fluid might be diminished ?—Yes, and also they might set up septic infection.

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5401. You have made experiments upon common vaccination lymph for small-pox, and you have found that contaminated ?—Yes.

5402. And you have found the same micro-organisms as in Haffkine's fluid ?—No, not necessarily the same micro-organisms.

5403. Do you think vaccine lymph has more or less dangerous micro-organisms than Haffkine's ? You are dealing with two vaccine fluids; in both you have foreign micro-organisms : do you find more in vaccine lymph than you do in Haffkine's fluid ?—In certain cases I think it contains more.

5404. Do you refuse to use vaccine lymph as a prophylatic against small-pox because it contains foreign micro-organisms ?—We inoculate only a very small quantity.

5405. So you think you inoculate more micro-organisms when using Haffkine's fluid than you do when you use the other ?—Yes.

5406. That is your ground for withholding it ?—Yes.

5407. Does it occur to you that this vaccine material of Haffkine's might be rendered perfectly sterile by heating three times to 60°C ?—Yes.

5408. And in view of that did you recommend Dr. Lawrie to oppose the use of this fluid, or do you think it might safely be used after having been sterilized three times ?—I think it might safely be used after re-sterilization.

5409. You have made a statement that rabbits, though they are very susceptible to disease, do not appear to liberate the plague : does that mean that the plague bacillus does not escape into the world in the excreta of rabbits ?—They would spread disease if they get enteritis or pneumonia or external hæmorrhages.

5410. What is the meaning of the statement that they do not liberate plague into the external world ? The importance of your statement lies not in connection with rabbits but it lies in the fact that one might base on it an inference with respect to rats : I presume every animal that gets disease passes bacteria on into the outer world ?—Yes.

5411. (*Dr. Ruffer*).—In the experiments on rabbits Nos. 53 to 58 you say, "all the animals in this batch were inoculated with solutions in water of scrapings from infected houses" ?—Yes.

5412. So that there was no doubt about the houses being infected in that case ?—The scrapings were sent to me from the Deputy Plague Commissioner.

5413. You are satisfied that they were infected ?—Yes, in two cases.

5414. Two died of plague, two of tetanus, and two are alive ?—Yes.

(Witness withdrew.)

MR. A. H. STEVENS, called and examined.

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5415. (*The President.*)—I believe you are Deputy Plague Commissioner of Hyderabad ?—Yes.

5416. You have had a good deal of experience in connection with plague duty ?—Yes.

5417. Commencing when ?—Last January.

5418. From what kind of experience are the conclusions you are about to give us arrived at ?—From having lived in the infected villages themselves, and from having visited, I think, the whole of the infected areas in the Hyderabad State. I have remained in camp the whole of the past eleven months excepting about six weeks in the rains, when I was in Hyderabad.

5419. When did plague first show itself in the Hyderabad territory ?—It was first known in Hyderabad territory in December 1897; but I think it is exceedingly likely that it was in Hyderabad territory for two months before that date.

5420. When did it first become indigenous ?—Plague had been indigenous for some weeks before we first discovered it at the end of 1897.

5421. From that time until now how many districts or villages had been attacked ?—Sixty-seven villages have been attacked.

5422. Can you put in a list of them ?—The following is a list I have prepared :—

Total Plague Attacks and Deaths in His Highness the Nizam's Dominions, from commencement of outbreak up to 12th December 1898.

Serial number.	Name of Villages.	Name of Talukas.	DATES.		PLAGUE TOTALS.	
			From	To	Attacks.	Deaths.
1	Ganjoti	Ganjoti	12th January 1898	30th March 1898	243	238
2	Umarghi	Do.	25th December 1897	30th „ „	194	188
3	Terrori	Do.	7th February 1898	26th „ „	25	22
4	Chincholi	Do.	9th „ „	26th „ „	1	1
5	Balsoor	Do.	13th „ „	29th „ „	61	51
6	Maraj	Do.	16th „ „	13th April „	50	44
7	Sangvi	Do.	12th „ „	13th „ „	1	1
8	Dallim	Do.	1st „ „	14th „ „	4	4
9	Wadi	Do.	16th „ „	13th „ „	4	4
10	Chandkhal	Do.	11th „ „	13th „ „	3	3
11	Koragaon	Do.	21st June „	14th November „	37	30
12	Gogalgaon	Do.	14th July „	8th „ „	24	17
13	Wadi	Do.	22nd August „	8th „ „	25	21
14	Waghadhari	Do.	13th September „	8th „ „	38	33
15	Kajurgi	Alland	24th January „	29th March „	22	21

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Total Plague Attacks and Deaths in His Highness the Nizam's Dominions from commencement of outbreak up to 12th December 1898—continued.

Serial number.	Name of Villages.	Name of Talukas.	Dates. From	Dates. To	Plague Totals. Attacks.	Plague Totals. Deaths.
16	Nagrall	Alland	4th March 1898	2nd April 1898		8
17	Akoondi	Do.	13th „ „	29th March „	2	1
18	Lohara	Do.	4th December „	10th December „	24	24
19	Parsalgi	Do.	25th November „	10th „ „	16	15
20	Alanga	Do.	8th May „ 20th October „	18th May „ 8th December „	26	23
21	Nanaz	Tuljapur	1st February „	27th March „	69	55
22	Karumba	Do.	13th January „	27th „ „	63	54
23	Warzygaon	Do.	4th January „	27th March „	24	20
24	Kadkey	Do.	30th December „	27th „ „	42	35
25	Dhotry	Do.	14th November „ „	27th „ „	73	66
26	Tambulwadi	Do.	27th February „	8th December „	17	16
27	Sassora	Do.	3rd October „	8th „ „	135	91
28	Jalkotewaddy	Do.	3rd „ „	8th „ „	32	21
29	Savargaon	Do.	3rd November „	8th „ „	22	19
30	Katgaon	Naldurg	22nd March „	25th „ „	13	8
31	Keshagaon	Do.	28th December 1897	29th „ „	52	39
32	Sarati	Do.	1st January 1898	4th February „	24	20
33	Babulgaon	Do.	12th July „	20th July „	16	7
34	Astha	Paranda	12th „ „	20th „ „	46	36
35	Khyrow	Do.	18th October „	20th „ „	57	37
36	Dongargaon	Kallyani	16th „ „	20th „ „	14	10
37	Kotmall	Do.	17th September „	1st December „	22	19
38	Balkunda	Purthabpur	17th „ „	1st „ „	41	32
39	Sidnikop	Yelburga	16th „ „	8th „ „	219	215
40	Bannikop	Do.	27th „ „	8th „ „	428	371
41	Binhal	Do.	1st November „	8th „ „	104	84
42	Sampur	Do.	31st October „	8th „ „	66	57
43	Erihanchnol	Do.	31st „ „	8th „ „	71	67
44	Mannapur	Do.	31st „ „	8th „ „	35	27
45	Dotihal	Kustagi	31st „ „	12th „ „	109	89
46	Sirguppi	Do.	31st „ „	12th „ „	145	114
47	Gwatgi	Do.	31st „ „	12th „ „	28	21
48	Hulgeri	Do.	31st „ „	12th „ „	48	41
49	Manerhal	Do.	31st „ „	12th „ „	21	21
50	Kessur	Do.	31st „ „	12th „ „	49	45
51	Ramvanki	Do.	31st „ „	12th „ „	1	1
52	Ramthal	Do.	18th November „	12th „ „	5	5
53	Vandali	Do.	5th „ „	12th „ „	2	2

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Total Plague Attacks and Deaths in His Highness the Nizam's Dominions from commencement outbreak up to 12th December 1898—concluded.

Serial number.	Name of Villages.	Name of Talukas.	Dates.		Plague Totals.	
			From	To	Attacks.	Deaths.
54	Todkeri	Kustagi	30th November 1898	12th December 1898	1	1
55	Balwatgi	Do.	4th December "	10th " "	7	6
56	Nagarhal	Mudgal	24th " "	10th " "	65	65
57	Seyjulgooda	Do.	24th " "	10th " "	82	82
58	Pallugunudini	Do.	24th " "	10th " "	1	1
59	Tambulgooda	Do.	24th " "	10th " "	1	...
60	Nowli	Do.	24th " "	10th " "	6	6
61	Sirsi	Nilanga	9th November "	11th May "	66	65
62	Kungara	Lahora	9th " "	12th " "	46	41
63	Gowloor	Kopbal	15th September "	12th " "	539	507
64	Gudlanur	Do.	15th " "	12th " "	92	63
65	Palaskhira	Ajanta	15th January "	17th April "	89	78
66	Budgaon	Bhir	3rd February "	17th " "	29	16
67	Kannar	Do.	3rd " "	17th " "	15	15
				Total	3,971	3,440

5423. What is the total number of cases?—The total number of attacks are 3,971, and the total deaths 3,440, up to the 12th of December 1898.

5424. I think you have a map* which will illustrate the course of the invasion of plague into this territory?—Yes.

5425. Will you kindly explain it to us?—Altogether there have been four different infections at various times. The first infection was from Sholapur, which infected the talukas of Nuldrug, Tuljapur, Ganjoti, and Alland. Subsequently, ten months afterwards from the same source (Sholapur), the taluka of Paranda was also infected. Sholapur is on the Railway line, and comes within two miles of the first infected village in the Nizam's country. This was the first infection. Shortly afterwards two villages were infected from Ahmednagar, and the taluka of Bhir, that is, the villages of Kannar and Dowlabudgaon.

5426. Will you give us the dates? There appear to be some mistakes in the list?—I have given the dates of each of the separate villages. One village might have been infected three or four months later than the other. Speaking generally the infection in Sholapur began in the commencement of 1898, in the month of January; we discovered it in Bhir from Ahmednagar about six weeks later, and Palaskira from Kandesh about a month later. We only heard of the infection in Lingsagur and Kopbal in October of the current year. There was no infection there during the last cold weather. The infection in Lingsagur has been imported from Bijapur, which I think was free from plague last cold weather. Dharwar is responsible for the infection we got at Kopbal. I think there was no plague in Dharwar last year.

5427. Is the extension still proceeding?—Yes, slightly.

5428. I think some new villages have been recently attacked?—Yes.

5429. Where are they?—Yesterday I heard of one village where there had been one death, next to Kowloor in Kopbal. I heard of one village close to Lingsagur where there had been one death. I heard of one village in Ganjoti where there had been two deaths. The fourth was in Lingsagur.

5430. In some cases you have ascertained the source of the infection?—Yes.

5431. There appear to be some detached areas surrounded by uninfected areas in the Nizam's territory. Do you think the first infection came from outside or from other portions of the Nizam's territories?—There are only two places I am doubtful of—Kalliani and Partabpur. The infection was imported there about three months ago when there was plague going on in the Akalkot State. Plague was going on simultaneously in that State, about three or four miles away, and in the Nizam's territory also three or four miles away; but it is impossible to say whether the infection came from that State or from the Nizam's territory. Of the other sources of infection there is not the least doubt at all that they have been from British territory.

5432. Not the least doubt?—No.

5433. Why?—Because there were thousands of these people suffering from plague when I went round there. A large number of them were sent back by me with the Police to the Collectors of British districts. I got receipts for them.

5434. I wish to ask you something about plague administration in the next place. I believe you have had considerable difficulties to contend with: what have been the most serious?—The want of early information.

5435. How do you account for that?—I think it is due to there being no general system. Every body is only too anxious to get rid of plague at any price when it breaks out; thousands and tens of thousands of plague refugees come into the Nizam's country, and we know nothing about it till too late. A large number of sick leave their villages which they have infected, and reduce the risk and chance of plague spreading there but we get no information about it. As a rule, the first notice we receive of it is that we find groups of villages with hundreds and thousands of plague-infected people living in them.

5436. Are the tracks of ingress watched?—I think it is impossible.

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* Not printed with the Commission's Proceedings.

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5437. After plague has appeared, what is the next step you adopt?—The first step is to find out how far infection has extended. We take a census of the villages suspected and ascertain as far as possible the furthest point to which plague has already got, and also endeavour, as much as possible, to keep each village community compact and not let them split up and go to other places, and we get rid of all refugees as quickly as possible by sending them back to their own districts.

5438. How do you prevent villagers from scattering themselves?—By, as far as possible, preventing them gaining admittance anywhere else, and, as far as possible, persuading the village headmen to make them personally responsible, so that if these people go away they will be sufferers. If they have good standing crops they will not go away. The difficult class of people to deal with is those who have no land holdings at all, the shop-keepers, weavers and artizans, who have no vested interest in the village. But the villagers themselves who hold land will not leave their crops. They cannot leave their flocks, crops, and agricultural instruments, they will not go away. With the shop-keepers and artizans it is a difficult thing, in fact it is at times impossible to prevent them going.

5439. What machinery have you at your hand for carrying out these measures?—As much as possible, I do the work through local Revenue, Police and Medical officials: but I do not find that is quite sufficient. As a rule, I place four or five sepoys in each village to give a daily report of what is going on. They have no particular instructions, but they are to tell me exactly what is going on, if people are coming and going and if there are deaths and burials, to keep me informed of what is going on in the village. We have a certain number of cavalry who have certain groups of villages under their control, and they are supposed to go about and find out from these infantry sepoys what is going on in the villages. For detecting plague I invariably give a reward of Rs. 10 to any body who can tell of a *boná fide* infected village which has not already been reported by the Revenue people.

5440. Have you found many in that way?—It answers admirably.

5441. By offering a reward you discover infected villages which you otherwise would not find out?—The sawars go out in plain clothes and act as spies. No reports are accepted unless they are proved.

5442. In how many cases are they successful?—I should say twenty. In the last ten days I have had eight cases.

5443. When an imported case is discovered in a village what do you do in the first instance?—I should have the house in which the imported case occurred, and perhaps dozen houses round it, evacuated; and I should have the floor of all those houses taken up and burnt.

5444. In addition to that would you have any disinfection?—Last year we used perchloride of mercury after the new floor was put down. We have large copper caldrons and boil the people's clothes in them as soon as they go out. Of course it is rather difficult to make certain that all the clothes have been boiled, but as far as possible we have them all boiled before the people go back into the villages again. The people do not object to their clothes being boiled, but they have a great objection to their bedding being boiled, they think it spoils it. When cotton quilts are boiled, I do not think they are much good for bedding purposes again.

5445. What kind of houses are there in Hyderabad?—The class of houses differs with the district. All round Sholapur the houses are thatched and tiled, but towards Kopbal and Lingsagur there are no thatched or tiled houses. All the houses round Lingsagur have thick earthen roofs; and toward Kopbal a certain number of the houses have cemented roofs; earthen roofs are all made of mud, laid on beams, and rammed down tight.

5446. And they are supplied with openings for ventilation and light?—A great many houses are so dark, even in mid-day, that it is absolutely impossible to see anything unless one has a lantern.

5447. Do you include in your measures the opening up of these houses?—No.

5448. You leave them as they are?—Yes.

5449. What has been the success?—The success has been that in every village in which we have dug up the floors and burned them we have, up to date, had no return of plague. There is one village, Alunga, in which we have had a return; it is close to the two infected areas, Akalkot and Ganjoti It is possible that Alunga may have been re-infected. There were six cases of plague among the leather-workers. I think they all proved fatal. It was in that part of the village where the chamars lived. As far as I can recollect, the outbreak occurred at the end of May, because I know I only had time to go out there before the rains broke. When I went out there I found that in the chamars' quarter about twenty-five houses had been evacuated, and the floors had been destroyed by burning. I always tell them when I go on inspection not to remove any of the kilns in which floor earth has been burnt until I have seen them, because I like to satisfy myself that the burning has been properly carried out. I found that the other houses in Alunga had been cleaned and white-washed. As the whole of the leather-workers had evacuated, and the surrounding houses were evacuated also, and as it was so near to the rains, I told the people that unless there were any further cases I would not evacuate the remainder of the village. There were no other cases. I looked upon Alunga for some time as perhaps one of the most successful experiments we had had. But some few months ago there were some other cases, and there are still a few cases going on there. The village is now entirely evacuated, but it is the only village out of the whole of the villages during the last cold weather in which we only partially destroyed the floors of the different houses. The reason of that was that it was the only instance close on to the rains in which plague broke out. In all the other villages plague died out, as far as I can recollect, about the middle or end of April. We had a few cases in the camps, and then they stopped. For nearly a month there was not a single case of plague in the whole Dominion, and then we had this outbreak in Alunga.

5450. And only there?—Yes, only there.

5451. How long do you generally keep the people out of their houses?—That depends on a variety of circumstances. It depends a great deal on how long the village has been infected. If one or two cases have occurred in a village, and the village is evacuated at once before the disease has got a firm hold on the village, it is quite likely that in a fortnight or three weeks the plague will have entirely gone away from the camp, there will be no sign of it. If there are no deaths where the evacuated people are living, I should say that a month from that time would be quite safe to let the people go back again; but it would be manifestly very foolish when deaths occur in camps, no matter how long the people have been out, to let them go back into the village. When the rains come on, it is impossible to keep the people in some places, but I should always keep them out, if necessary, for months and months, so long as there were deaths going on in the camp.

5452. When there have been a considerable number of plague cases in a village, do you endeavour to evacuate the whole village?—Invariably.

5453. What have been the populations of the villages you have succeeded in evacuating?—The largest population is 6,000 or 7,000. That is the village of Kowloor in Kopbal. I have had several villages of 5,000, and a large number of 4,000. In some of the districts the villages number 1,000 and 600.

5454. Have you encountered much difficulty in this process of evacuation, much opposition?—No.

5455. Will you explain to the Commission how you manage to induce the people to go out?—What difficulty there was, was at the commencement. Nowadays, for partial evacuation, there is no difficulty at all, because as a rule the people evacuate the villages themselves. They know that it is a good thing to leave their villages, and in a large number of instances, in Lingsagur and Kopbal, I have found the villages evacuated sometimes before any plague was reported. I enquired the cause why they have been evacuated, and I have been told that the rats were dying, and that the people had fever, but had recovered, I think myself there is not the least doubt that now-a-days, at all events in the Nizam's Dominions, wherever plague breaks out, if it is in the neighbourhood of other plague infected localities where people know something about the disease, the landowners either partially or completely evacuate their homes in the village at once. Shopkeepers will not leave a village: they stick there; and weavers will not leave a village; they have no particular place to go to: they have no crops or cattle to look after, and it costs them a lot of money to make camps outside; whereas, the ordinary agriculturist every year spends a certain amount of time actually camping out in the fields. It is no hardship for him to go out at all. The only thing that troubles him is what to do with his worldly possessions. He has a large amount of grain, and other

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things, stored in his house. If he does not take it away with him into camp, he is liable to be robbed of it. If he takes it away, it means a lot of trouble and expense: he has got to get bags, and carts, and one thing and another. But the agriculturist is quite willing to evacuate, without any pressure at all. He quite understands the advantages of it, and he will partially evacuate almost before he can get an opportunity of being told to go out.

5456. How do you overcome the difficulty with the weavers and shopkeepers?—Frighten them out, use every legitimate means to get them out. For instance, about a fortnight ago, there were a lot of weavers who would not turn out. I went down to the village myself and sent for them. I took the names down of the men there, and I said, "You are very foolish not to go out of your own accord, you will all be served with a notice to go out to-morrow, and if you do not carry out that notice, you will be prosecuted, and summoned, and put to a great deal of expense. You may be fined, and you may be imprisoned. Whatever the Government do is for your good. You had better go out the same as other people who are in a much better village, and have a great deal more sense. If you do not go out, you will be sufferers." I have told the village people and persuaded them, and I have told the police to do their best to get them out. As a rule, they have always gone out. I have never had any people who actually refused to go out, not a single case.

5457. Do you supply them with camps?—No.

5458. Not at all?—No.

5459. Do you limit the position to which they can move themselves, or can they go wherever they like?—That largely depends upon the water-supply. In many of these villages they can only camp where there is water. As a rule land-holders much prefer to go into their own fields because they protect their own crops; otherwise, provided they keep within a reasonable distance of the village, I think the more scattered they are the better. It is a disadvantage if they go five or six miles away; but, provided they stay within two or three miles of the village, I think the more broken up the camps are, the better: I do not think it is a good plan to have large camps.

5460. What do you consider from your experience is the maximum population that you could evacuate?—I have no hesitation in saying, as far as my experience goes, that the figure is 70,000. I have seen 70,000 completely evacuated without any trouble at all.

5461. You think that all towns whose population does not exceed 70,000 may be evacuated?—I think that depends upon other circumstances.

5462. What other circumstances?—I think a town of 70,000 Hindus would be very easy to evacuate; but a town of 70,000 Muhammadans would be almost impossible to evacuate.

5463. Muhammadans are much more difficult to deal with?—Certainly, they have their question of zanana, which is the most troublesome thing of all in evacuation.

5464. Do you take any precautions in regard to the areas surrounding an infected village or district?—Certainly.

5465. What precautions?—I have sepoys posted in every village. The police are warned not to let anybody come in. The census being taken periodically, if there is any suspicion of people going away, the census is checked. I think those are all the precautions. I do not think that anything else can be done.

5466. When do you disinfect the clothing and bedding after evacuation?—If possible, we do it twice. It is as well to boil it as soon as possible after they go out, and it is as well to boil it the last thing before they move in. They are so pleased at the prospect of getting back again that they do not make any difficulty about boiling their things a second time when they are just coming back into their houses.

5467. You have already described the process you adopt for disinfection?—Yes.

5468. You prefer that to the use of any antiseptics?—Certainly.

5469. Please to describe what you regard as the special advantages of these kiln methods?—I think the special advantages are that it is effective. When the whole of the floor has been dug up and burnt, I believe the floors are then as healthy as they can possibly be. I do not think there is the least danger of any infection remaining in them. It is a thing which can be done at once: there is no delay in getting chemicals, or anything of that sort. The materials used for it are well known to the people themselves. The house-owners themselves do the whole of the work. They get the fuel, they dig up the floors, they set fire to it themselves, and when it is burnt out, they remove the ashes, and put them on the fields. They see the whole thing through from start to finish. It costs the Government nothing at all, and it is an exceedingly simple way. Everybody understands it, and they know perfectly well that anything which is dirty, and which they want to get rid of, the simplest way is to set fire to it and burn it to ashes.

5470. You have adopted this plan generally, without it being supplemented by any disinfection?—We have used a certain amount of perchloride of mercury in the villages round Sholapur, but I have not used perchloride of mercury in Kopbal or Lingsagur. I do not think it is necessary: fire disinfection is quite sufficient.

5471. Has plague ever broken out again?—No, except this one village I have mentioned—the village of Alunga. We have had no return of plague in villages which I have been treating by this process.

5472. (*Dr. Ruffer.*)—Is this process carried out in the house, or outside the house?—Outside the house. If it is a very large house, it may be necessary to have more than one kiln, but if it is an ordinary-sized house, I always fix in front of the doorway of the house a kiln. Each house has its own kiln; it does not flame up, and it is not necessary to have it removed a great distance away. The nearer it is to the house, I think it is the better. They have a shorter distance to carry out the dug-out floor earth, and it is much easier to check it afterwards, in going round a village. At the doorway of each house you find a kiln, or kilns, according to the size of the house already burnt out.

5473. (*The President.*)—Does plague affect any special castes?—Certainly.

5474. What castes?—I think that the low caste Hindus are much more liable to it than anybody else. I think that the Banniahs and the Lingiats are more liable to plague than any other class. I do not think the labouring classes are so liable to it as shopkeepers and the lower class cultivators. The herdsmen and shepherds have almost a perfect immunity from it. Perhaps I am not able to judge exactly of Muhammadans, but I think Muhammadans are less liable to it than the Hindus. The Muhammadan population in our villages, however, is very small.

5475. (*Mr. Cumine.*)—Do you include Banniahs and Lingayats among the lower caste Hindus?—Yes.

5476. (*The President.*)—Have you formed any opinion as to why this difference should occur: has it anything to do with habitations, or exposure in work to the open air?—I think that both the Lingiats and the Banniahs are not very cleanly in their habits: the Banniahs are filthy. I think Brahmans escape because they are very clean. Muhammadans perhaps escape because a great many of them wear trousers and shoes, more than the Hindus. I think the herdsmen escape because they stay little in their houses, spending night and day out in the open fields. These are only my opinions: they may be quite wrong. I have no means of proving what I say.

5477. Do you find those who live in the most non-sanitary houses are most liable to be infected?—Not necessarily.

5478. Can you give any examples?—I will give the examples of the labourers. The Dhers and Mangs, the lower class labourers, who feed on carrion and all kinds of offal and live in the most filthy hovels, are not so liable to plague as shopkeepers. I think the reason of that is that their houses are more exposed to the air. They are smaller houses, and they have less protection from the sun and the air than the houses the shopkeepers live in.

5479. The shopkeepers also are necessarily brought into contact with a large number of people, I suppose, who may or may not be infected?—Yes.

5480. But I suppose you will agree that as a general rule, plague occurs most abundantly in the most non-sanitary habitations?—Certainly.

5481. You have given attention to the locality of the plague bacillus itself in an infected house I think?—Yes.

5482. Could you give some account of what you have done, and of what you have found?—Prior to the time the Plague Commissioner, Dr. Lawrie, came to my camp, I had never used the microscope. I knew nothing at all about it, but Dr. Lawrie showed me certain appearances in floor earth under the microscope which he said were indicative of plague, and found in houses where there was plague.

5483. What is that appearance?—Some of the photographs* give the appearance.

5484. In the field of the microscope you see certain objects?—Yes. Then I learnt how slide preparations were made and as far as my own experience goes,—whether the appearance is a bacillus or a microbe, or merely earth, or infection, I do not know,—but as far as my experience goes, wherever there is plague, under the microscope the earth has a certain peculiar appearance which you do not get anywhere else, no matter how filthy the houses may be.

5485. Do you mean you found certain bodies?—Yes, certain bodies.

5486. You have found these bodies in houses which were not infected?—No.

5487. Only in houses where there is plague?—Only where there is plague.

5488. How do you proceed in taking your specimens?—I go into a house and ask whether any people have been ill. If they say, "yes", I ask where the sick people have been lying. They show me the places. I take some earth, and stain it and examine it under a microscope.

5489. You stain it yourself?—Yes.

5490. In how many cases have you done that?—I should think I have examined a thousand or fifteen hundred.

5491. (*Dr. Ruffer.*)—Have you any microscopic preparations we could see?—Yes. I have not been using the miscroscope for the last two months, but the day before I left Kopbal I thought I might be asked for some, so I went into one village and made four preparations. Those I have got and they give exactly the same appearance as the earth in Bombay or Sholapur, or wherever we have had plague.

5492. Where after finding these bodies in an infected house, you examined the earth at a distant interval, did you fail to find the same bodies?—Yes, they have certainly got very much less.

5493. You have not failed altogether?—Well, the characteristic appearance goes.

5494. I asked whether you could describe the appearance; perhaps you would prefer to show the slides?—The whole slide is filled with masses of a sort of oval organisms, some in chains, and some in great lumps, altogether more like lumps of fish roe than anything else.

5495. What about the colour?—That depends upon the stain.

5496. What did you observe about the colour?—I sometimes used gentian violet, sometimes fuchsin, and sometimes blue stains. I found gentian violet the best.

5497. Do these bodies stain homogeneously or not?—I think, as a rule, the centre was lighter coloured,—certainly it was lighter coloured.

5498. Have you formed any opinion as to how plague may be conveyed; will you kindly tell us how?—I think it is conveyed by people suffering from plague going into villages and giving it to others. I think when once it gets into the floors of the villages, all the villagers themelves get it. I do not know whether rats convey it. I have seen a good deal about rats in the newspapers, but personally I must say I am rather sceptical whether rats convey it or not.

5499. Have you any very definite example of infection being conveyed by one human being to another?—Yes.

5500. Could you mention any cases?—In the case of the village of Kajurgi, a Banniah came from an infected village and died, and in that house three weeks afterwards nine other people died. I think it was nine or eleven that died of plague, including two servants. They were not relations, but simply servants, a barber and a cook. They both died in the same house. The whole account of it is given in the report, as well as other particular cases.

5501. What report do you mean?—The printed correspondence; † my letter No. 116 of the 16th of February. I telegraphed to the Plague Commissioner about the village of Kajurgi. I said in my letter as follows:—

> "In my telegram of to-day's date I have informed you of an outbreak of plague in the village of Kajurgi, Taluka Alland, in the ilaka of His Excellency the Minister Sir Vikar-ul-Umrah. Two days ago I received information of three sudden deaths in the village. A search party was therefore sent out to make enquiries, and their report is as follows:—"About 20 days ago a Hindu from Umarghi named Irbudruppa came to Kajurgi and died three days ago. The person in whose house the original death occurred, by name Chandbasappa, his wife and mother, all living in the same house, were suddenly taken ill and died."—I should say unquestionably from plague. I am going to Kajurgi to-morrow to make personal enquiries and will advise you by wire of the result."

That was my first report before I visited the village. Subsequently the whole of the family in that house died. I see that the second report was made when Dr. Lawrie went with me. In his letter, No. 557 of 5th March 1898, he writes from Ganjoti to the Secretary to Government, Hyderabad, as follows:—

> "I have the honour to report that Mr. Stevens and I, with Hakim Syed Mahomed and Captain Wahid Ali Khan, went from here to Kajurgi at 6 A. M. to-day. We spent the day there disinfecting four houses and returned at 5 P. M.
>
> "2. The history of these houses is interesting. The first house disinfected was that of a wealthy Banniah. A man arrived in this house forty-five days ago from Umarghi. He died of plague on the third day after his arrival. The people state that there was no other case of sickness in the house afterwards for twenty days. The whole of the Banniah's family there got plague one after the other, and the Banniah himself and eleven males, making with the first case from Umarghi, thirteen in all, died. The only survivors are the grand-mother, the wife of the Banniah, the wife of one of his servants and three little children. Since the outbreak, the survivors have lived outside the village in an isolated hut. No. 2 house was the shop attached to house No. 1. Houses Nos. 1 and 2 accidentally caught fire while the floors were being disinfected and were burnt down. This caused great rejoicing among the villagers, and it was in my opinion a most lucky accident. The third house we disinfected was a sort of private temple, a mutt, to which the unfortunate Banniah was taken for two hours when he was dying. We were in grave doubt as to whether it was necessary to perform any drastic measure of disinfection in this house, but the people were so insistent that it should not be passed over that we burnt the floors, and it will be drenched with the bichloride solution and lime washed like the rest of the infected houses elsewhere, before it is re-inhabited. The fourth house was the last place to which the Banniah was taken, and from all accounts he must have been dead when his body arrived there. It was treated in the same way as house No. 3.
>
> "3. A girl of the age of eight years died at Kajurgi just before we arrived there this morning and the corpse was kept for us to inspect. There was a bubo under the right arm, no enlargement of the spleen, and the usual history of plague. To show how anxious the villagers are to get rid of the disease, this girl was isolated by them directly she was taken ill, in a hut in the fields, and no one but an old woman who has had plague was allowed to attend upon her. The hut was burnt down and the old woman will be herself isolated for ten days and the hut she is in will be burned."

That was the clearest case of a man coming from an infected district and dying, and there being a total absence of plague in the village for three weeks—twenty days clear. In that time it seems to have got exceedingly virulent, because the whole family were wiped out, including servants. All that remained were the old grandmother, the wife of the first man who died, and two small children. That is the best and clearest instance. I have the names of all the people, and there are no links in the chain of evidence that are wanting.

5502. Did it spread in that village?—Yes.

5503. At what interval of time?—Almost immediately afterwards.

5504. Was there any history of dead rats being found?—No, there was no history of dead rats in that village.

5505. Not at all?—No, we heard of no history of dead rats.

5506. Was there much plague in the village?—No, there were 22 attacks and 21 deaths, out of which nine or eleven were in this house.

5507. I suppose the measures you adopted checked the plague?—We turned the people all out. It happened at a good time; it was in the hot weather. I do not think plague spreads so quickly in the hot weather as in the cold weather, or in the rains.

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* See Appendix No. XVIII in this Volume.

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5508. What, in your opinion, are the chief routes of conveyance of plague: is it carried from one place to another?—I think by the railway more than anything else.

5509. It is in accordance with your observation?—Yes.

5510. Next to that?—Next to that I think it simply depends upon where plague breaks out. Wherever plague breaks out on the frontier, whether there are roads or not, if it is on frontier, they come into the Nizam's territory. I think as a rule when people are bolting from plague infected villages, they avoid the roads, and go across country as much as possible, as they know there is more chance of being stopped on the main roads where there is the police. I say it is absolutely impossible, with a frontier like the Nizam's frontier, to keep out people coming from British territory. If one had thousands and thousands of troops one could not do it.

5511. Have you used inoculation largely?—Not at all.

5512. All these results (some of them very favourable) which you have given us, have been independent of inoculation?—Yes, I have never seen inoculation done, and none of the people that I have had out with me, as far as I know, have ever seen a case of inoculation. I certainly never have had any of Haffkine's fluid, nor has any been sent out to any of the plague infected districts.

5513. Have you made any endeavour to induce people to allow themselves to be inoculated?—No.

5514. (*Mr. Hewett.*)—You have had great experience among people in connection with plague; have you come across any instance in which a person not having plague himself, conveyed it to another person?—No.

5515. You know of no infection through clothes alone?—Not as far as I know.

5516. You think that the people always say that rats begin to die first, and then plague comes; have you come across any ascertained case in which there has been no plague before rats began to die?—Yes, certainly.

5617. No suspicious deaths?—No.

5518. Can you give us the names of the villages in which you found this to happen?—The village of Balutgi. I heard there was a great deal more plague in Lingsagur than had been at first reported. I therefore took down a party of sowars, and sent them off with a promise of reward to go and see if they could find any villages. They came back to me and reported that there was plague in some three or four villages, and that there were two villages (one of them was the village of Balutgi) in which the people had told them that the rats had already commenced to die. That was why the people left the village. Balutgi is in the taluka of Lungsagar. In another village, also perfectly evacuated, they could not find anybody from whom they could obtain any information. I asked subsequently from the Revenue people, and they said that the rats had died in that village too. My evidence of that is not complete. The other case, however, I have notes of in my pocket book, to the effect that the village of Balutgi was evacuated on account of the death of rats. I think about a week or ten days after that one or two deaths occurred in Balutgi.

5519. But there have been none before that?—No.

5520. Any suspicious deaths before that?—No.

5521. You think that evacuation must be complete, and that not only all the inhabitants of the village must go out but all their cattle?—Yes.

5522. Do you find any difficulty in making the people do that?—Yes, there is a certain amount of difficulty.

5523. Had you any plague during the rains?—Yes, we had.

5524. Did you evacuate the infected villages then?—We partially evacuated.

5525. Did you find complete evacuation impossible at that season?—It was the end of the rains when we had an outbreak at Babulgaon. First of all the infected houses were evacuated and directly the rains left off the whole village was emptied out and the whole of the houses dug up.

5526. Supposing that you had an outbreak of plague among a large number of villages during the rains, would you be able to evacuate them?—It would depend a great deal upon the soil.

5527. There are certain tracts in which you would not be able to evacuate the villages?—Certainly; there are certain places where you could not evacuate them.

5528. What do you think could be done in those places to stay the plague?—I should think the best way would be to divide each house as far as possible into two, and first of all to dig up and burn half the floors; then move the people into the part of the house which was cleaned out, and dig up the other half. If after that they had plague, then repeat the process. I think in time, if you could not evacuate the people, that would be the best way of purifying the houses.

5529. I see you give as a reason for not commencing the disinfection of houses, or digging up floors until ten days after a case is reported, that the disinfecting work is more dangerous up to that time; have you had much injury to your disinfecting staff?—We had a certain number of deaths at Ganjoti and Umerghi, because when we commenced our operations we did not work on the same system which experience has proved to be better. First of all we had gangs of Government coolies, which we paid ourselves. Having evacuated a village, we put these coolies in and dug up and burnt the floors of all the houses. Afterwards we found the people were willing to do it themselves: in fact they preferred to do it themselves. It is better also in this way, that when we had these gangs of coolies working, perhaps for six weeks, on end at this work we had a certain number of deaths amongst them, whereas people just coming in and digging up and doing their own houses have far less chance of picking up infection than people who are simply stuck down to this work for a month, or a month and a half.

5530. Is it because that the danger of infection has gone at the end of ten days?—I do not say it has gone, but I think it is less.

5531. Why do you select ten days as the period? Would a longer period be better?—I think it is a good thing to get the place cleaned up as soon as possible. I look upon every infected village as dangerous, although you may have a village which is perfectly evacuated. People want to go in at night, and see whether any of their houses have been broken into, and robbed. You cannot keep the people away altogether.

5532. Supposing that you have a large village of, say, 7,000 people evacuated, do you lock all the houses?—Yes.

5533. With whom do the keys remain?—With the owners.

5534. It is only the guard that prevents the owners from getting back to their houses?—Yes, that is all.

5535. And with the guard, I suppose it is difficult to protect a large village of this size?—A good deal depends upon the locality. In some places there are a large number of thieves, and in some places a small number.

5536. The districts under you are always liable to invasion by people from British India?—Yes.

5537. You do your best to keep it off, but you cannot make certain of doing so?—That is so.

5538. You say that you encourage the villagers to keep out plague fugitives and refugees; you do not mean people actually suffering from plague?—No.

5539. But if a man cannot walk in a straight line, and walks about in a circle, would it be humane to send him away?—I should say "make a hut and let him stay there." I said plague refugees were sent back in charge of the police.

5540. You say that plague fugitives or refugees should be sent back to their own villages in charge of the police. Do you include in those people persons actually suffering from plague?—Certainly not.

5541. What would you do with plague patients under those conditions?—I should put them in a hut and take charge of them. If I found a cart-load of people coming into an uninfected village, in the Nizam's dominions, and I saw for certain that they had plague, I should turn the cart round and take it to three or five miles away and put the people into huts and keep them there.

5542. (*Mr. Cumine.*)—You quote as a proof of the effectiveness of burning floors the fact that in no village where the floors have been so burnt has plague resuscitated, except in one instance where the floor was partially burnt. But do you know of any cases in British India where plague has this fair season revived in villages which were disinfected with perchloride of mercury last fair season, or even not disinfected at all? I exclude cases where there has been a re-infection from outside: I refer solely to cases where the old germ has revived?—That is a very difficult question to answer. I know of plague breaking out twice in the same village, but whether it is re-infection, or the old infection has resuscitated, I could not give an opinion. It re-appears.

5543. What villages?—Akalkot.

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5544. Where?—In Sholapur.

5545. I think you have said that a population of 70,000 was the limit that could be evacuated?—I said that was the largest city I had myself seen evacuated. I did not say it was the limit: it was what I had seen.

5546. By evacuation, do you mean more or less immediate evacuation?—Immediate and complete evacuation.

5547. Was Sholapur the town you were thinking of. If so, was that immediately evacuated, or was evacuation not completed until the plague had got so diffused through the town that seventy or eighty people were being attacked a day?—I can only speak of what I saw myself. I went to Sholapur in January, and I found the whole place completely evacuated. There was not a single soul living in the town. All the inhabitants, except those who had bolted into the Nizam's country, were camped out in three or four camps round Sholapur. Whether they had done it at once or by portions of the city, I do not know. All I know is that the whole village was evacuated and kept evacuated for some three or four months.

5548. As regards receiving a warning from your neighbours in British India of an outbreak of plague, when plague began in the Sholapur district did not they telegraph to Hyderabad?—No.

5549. Did the Collector of Khandesh telegraph?—I had a telegram from the Collector of Khandesh six days ago.

5550. Was it not about this time last year that Khandesh was first infected?—I cannot be quite certain, but I think there was a telegram. I think we ought to go one step further than sending telegrams. I think some measures ought to be adopted by which the wholesale advance of thousands of plague people should be stopped. We certainly have never had any intimation at all of people having gone out by thousands and thousands into our country. We have had a telegram to say that plague has broken out in such and such a village, but that is all. It must have been known perfectly well. It was known that all these people were pouring into our country, but we were never told anything about it. It was only when I went out there myself that I found it out.

5551. By burning the floors you would destroy the microbes in the floors, but do not microbes live in the walls? May they not be in the walls a foot or two above the floors?—They may be, but I have been told that they are not. As far as my amateur examination of earth goes, I have not seen the same appearance in the walls as I have in the floors.

5552. (*Dr. Ruffer.*)—On whose authority do you make the statement that plague microbes are not found on the walls—you said you were told so?—I think it was in one of the Plague Commissioner's reports. I think it is in one of the papers before you.

5553. (*Mr. Cumine.*)—What do you do in the case of stone floors and wooden floors?—I am glad to say that I have not come across stone floors or wooden floors in the Nizam's country.

5554. If the microbe is in the dust on the floor, is there no danger in carrying the dug-up floor outside to the kiln?—Certainly; but if you read the process I have recommended you will see that the danger is lessened as much as possible. I recommend putting on a thick coat of whitewash to consolidate the dust as much as possible. I think there is danger in touching it, but it has to be got rid of and you cannot get rid of it without touching it.

5555. With regard to the lower caste Hindus, I think you said you include Lingayats and Banniahs. Do you include the ordinary cultivator?—Lingayats are the great cultivators.

5556. You spoke of the Dhers and Mangs. They are impure people, are they not, and not allowed to go into the ordinary villagers' houses?—They are impure people. They are largely employed as servants.

5557. Inside the houses?—Yes.

5558. Would they be allowed to touch the ordinary villagers?—That I do not know.

5559. When there are many villages infected, is it not difficult to get police enough to guard the evacuated village sites?—I do not have police as a rule; I have infantry.

5560. Have you noticed any case where plague appears to have burst out this year spontaneously without any infection from outside—in a village which was not infected last year, but which was close to another village which was infected last year?—A large number—Babulgaon, Gaogulgaon, Karogaon—altogether some 14 villages at least.

5561. (*Prof. Wright.*)—Will you describe your method of seeking for plague bacteria in the ground? Do you think that the method gives you important practical help in your plague operations?—I do not think it is a practical help much.

5562. I gather that you have not employed your method in your plague operations these last two months?—I did it lately for the benefit of the Commission, that is all.

5563. If it was only for the benefit of the Commission, we may then take it, may we, that you do not recommend it as a practical method?—I do not think it is necessary when you have plague now. When we first started one supposed the microscope was going to be of great use, but I do not think it is necessary now.

5564. That is the opinion everybody else has arrived at, and I do not think it is worth while cross-examining you about it unless you insist that your method of detecting plague bacilli in earth is a practical method?—I must say I think it is of use myself.

5565. But you do not recommend it as a practical method: you yourself have discarded it for two months?—I had not time. I was too busy. I was never staying more than twenty-four hours in one place. I had not time to unpack my microscope. There were plague people dying by hundreds. I did not want to look at the floors to see that there was plague. I could see from the deaths that the people had plague.

5566. (*The President.*)—Perhaps you will kindly bring your microscope to-morrow?—Yes, certainly.

5567. (*Dr. Ruffer.*)—The diary of your experiments has been put in,* but could we not have each experiment separately?—My work in the laboratory, I should say, was clerical work more than anything else. I sat down and jotted down what I was told. As to being examined on that laboratory work I may as well say that I do not think you will get anything scientific out of me because I do not think I know anything about it.

5568. (*The President.*)—You do not appear at all as a scientific witness?—Not at all.

5569. (*Dr. Ruffer.*)—We have this evidence with regard to the experiments before us; do you withdraw it?—I submitted it to the Plague Commissioner; it can be withdrawn or not as he wishes.

5570. It is "Condensed by the Plague Commissioner from the daily reports of Mr. Stevens, Deputy Plague Commissioner." That is the heading. Somebody is responsible for this report, and I want to know of whom I am to ask the questions?—I received instructions from the Plague Commissioner. I was in here and unable to be in the district on account of the rains, and he said, "We are going to have some experiments; I shall be obliged if you will keep a record, and let me know what is going on." I sat down and jotted down what was done. This condensed report is taken from the daily letters I sent in to the Plague Commissioner of what we have been doing.

5571. Then I take it that the Plague Commissioner is responsible for this report?—I merely carried out orders. I did not originate it.

5572. Am I to examine the Plague Commissioner on this report?—I do not think you will get much scientific information out of me.

5573. I see here, for instance, that some of the photographs are by yourself. I see that Nos. II, III and IV were "Prepared by Mr. Stevens"; whom am I to go to if I want information on this point?—As regards the making of the preparations of floor earth, I am quite prepared to take full responsibility. Wherever I was working I made preparations, and I sent the slides in to the Plague Commissioner: but with regard to the experiments made in the laboratory here, I was simply a spectator, and recorded what was done.

5574. (*The President.*)—I think Colonel Lawrie will be able to answer these questions to-morrow?—(*Colonel Lawrie*).—Yes.

(Witness withdrew.)

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* See Appendix No. XVIII in this Volume.

Captain Charles A. Johnston.

19th Dec. 1898.

CAPTAIN CHARLES A. JOHNSTON, I.M.S., called and examined.

5575. (*The President.*)—You are a Bachelor of Medicine and hold a Diploma in Public Health ?—Yes.

5576. You are in the Indian Medical Service ?—Yes.

5577. You have been engaged in working in connection with plague in the laboratory at Hyderabad ?—Yes.

5578. What is the nature of your work here ?—It is a purely voluntary one on my part.

5579. (*Prof. Wright.*)—You have made some observations with regard to the presence of plague in houses ?—Yes, two specimens of plague-earth from plague-infected houses came under my observation in the laboratory.

5580. Are those the only specimens of earth you have examined ?—Yes, the only specimens of plague-earth.

5581. Are those two cases included amongst the two cases of positive results we had from the last witness ?—I did not hear the last witness's evidence.

5582. Could you tell us how the specimens were collected ?—They arrived at the laboratory, but I do not know how they were collected. Investigations with regard to plague were being carried on when I came to the laboratory, about a fortnight after cultures and sub-cultures had been made.

5583. From these two specimens ?—Yes.

5584. The investigations had been carried to a certain distance before you took any share in the experiments at all ?—Yes.

5585. When you came, cultures had been made from these plague earths ?—Yes, from two samples of plague earth.

5586. What was your contribution to the business ?—I saw the sub-cultures, and Dr. Lawrie asked me to come in and have a look at the work which was going on.

5587. Were they pure cultures of plague when you saw them ?—They were impure cultures.

5588. Did you succeed in isolating a pure culture ?—Yes.

5589. Was that done by stroke cultivaton, or by passing it through animals ?—By stroke cultivation first, and also by inoculation in animals.

5590. Were these cultures made upon agar ?—Yes. They were grown after forty-eight hours. They were seen and recognized as colonies, very similar to colonies of plague. Hanging drop preparations were made. After that the fluid was inoculated into a rabbit, which died, and gave *post mortem* results very similar in all respects to plague. From the rabbit which so died the same bacillus was got out.

5591. Were you convinced that the rabbit was injected with a pure culture of plague ?—Yes, I was present when it was done. The culture was absolutely pure.

5592. In both cases ?—In both cases I got a pure culture.

5593. How was its purity verified ?—No other bacilli were found in the blood or glands except the one that was used for inoculation. Stroke cultures were made in agar from the blood and some sections of the spleen and other glands in the body and the ordinary peritoneal lymph glands, besides stained preparations of these fluids, and I had hanging drops on every occasion.

5594. Was Widal's test applied and with what result ?—No.

5595. Did you get a stalactitic growth ?—Yes, it was got from both those, anyhow for certain from one.

5596. (*Dr. Ruffer.*)—Was the bacillus motile in the hanging drop preparations ?—Yes, it was motile, but it was not actively motile.

5597. It went across the field ?—It was not what I call actively going right across the field as actively motile.

5598. Was it Brownian movement ?—It was feebly motile.

5599. Have you had much experience of the plague bacillus ?—No, not very much.

5600. Have you ever seen a plague bacillus motile before ?—No, not actively.

5601. Never ?—No. The only time I had a chance of seeing the plague bacillus was in Bombay, but they had not got a good specimen to show me. My experience with regard to plague outside the Nizam's territory is very small.

5602. Did you stain the capsules ?—No.

5603. You saw no capsulated forms ?—No.

5604. Neither in the culture, nor in the blood ?—No.

5605. Did you make any stab cultures in the agar ?—Not personally ; but I believe they were done.

5606. You have no knowledge of that ?—No.

5607. You do not know whether it grew in the depths ?—I do not remember having seen plague growths in the depths of the agar.

5608. In this particular bacillus did you see any growth in the depths of the agar ?—No ; I never suggested it should be made, but I believe it was made. I do not ever remember having seen any results from it.

5609. Did you try it on gelatine ?—No.

5610. Then you do not know whether it liquefied the gelatine or not ?—No.

5611. Did you try it on milk ?—No.

5612. Did you immunise animals with Haffkine's prophylactic fluid, and test it with this bacillus ?—Yes, that has been done.

5613. This particular bacillus ?—I am not certain, I did not do so myself personally. I do not know whether it was done.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Court House, The Residency, Hyderabad.

SEVENTEENTH DAY.

Tuesday, December 20th, 1898.

PRESENT :

PROFESSOR T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROFESSOR A. E. WRIGHT, M.I

MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

Lieutenant Lethbridge.

20th Dec. 1898.

LIEUTENANT LETHBRIDGE, I.M.S., called and examined.

5614. (*The President.*)—I believe you are in the Indian Medical Service ?—Yes.

5615. And you have done some inoculations at Belgaum ?—Yes.

5616. (*Prof. Wright.*)—Did you do any inoculations yourself in Belgaum ?—I did about 1,100 myself.

5617. Whom did you operate upon ?—The whole of the 26th Regiment, Madras Infantry, men, women and children, all but about 20.

5618. Was there plague in Belgaum before you did them ?—Yes, last year.

5619. Had there been any cases in the regiment among the women and children ?—Yes, several ; I do not know exactly how many. During the month I was there, there were eight cases altogether including men. There had been several cases the year before ; there were eight while I was there.

5620. What year are you talking about, and what month ?—About September and half of October this year.

5621. You say you went there in September ?—I went on the 5th of September, and left about the 15th of October.

5622. Before you went there, there had been deaths among this regiment ?—I think there had been about 40 last year, and five this year.

5623. While you were there, there were eight cases ?—Yes, eight cases altogether.

5624. And those all occurred before you began your inoculations ?—No ; all after, every one.

5625. When did you begin your inoculations ?—About the 10th of September.

5626. How long did it take you to complete them ?—I did them on two afternoons a week, 100 men a day. It took me about 10 days altogether to complete them.

5627. What doses did you inoculate with ?—Just above half the maximum dose in each case. The whole regiment had been inoculated the year before by Major Bannerman, the whole lot.

5628. Do you know what doses they were inoculated with ?—It struck me that the doses were high : I do not remember the figure at present; as far as I can remember, the doses were large, not implying that they were too high.

5629. Was all the vaccine you employed in good condition : did you find any putrid ?—No ; every bit was good. I tested the bottles myself.

5630. How did you test them ?—By smell and general appearance.

5631. Did you observe any bad symptoms after inoculation ?—A couple of the men had fever, two of the followers.

5632. Only two or three men had fever out of the whole lot ?—Yes. Those were the only men reported sick : there may have been other cases.

5633. You did not take the temperatures of any of the others ?—No, I did not.

5634. You only saw two people after inoculation, and they came to the hospital because they had fever ?—Yes.

5635. Did you find out whether any of the others had fever or any symptoms ?—I heard no complaints at all.

5636. Did you enquire as to whether they had any symptoms at all ?—No.

5637. You did not make any enquiries about them ?—No.

5638. In the case of these two men, did the fever last long ?—Two days. They were brought into the hospital and in two days they were discharged.

5639. Why did you use only half the dose ?—I thought, as inoculation had been done before, it was not necessary to use more.

5640. Were there several brews of vaccine used, or only one ?—Several.

5641. In each case you gave half the dose ?—Rather more than half the maximum dose indicated on the bottle.

5642. What about the results of these inoculations ?—I have not the figures with me. Of the eight cases five were fatal.

5643. You inoculated about 1,100 ?—Yes, altogether.

5644. How many cases had you afterwards among the inoculated ?—Eight cases of plague, and about the same number of suspicious cases. We did not exactly know whether it was plague or not. Four of them died.

5645. In how many of the eight cases was there no doubt of the diagnosis of plague ?—Five were fatal.

5646. At the same time, how many were occurring among the uninoculated ?—They were all inoculated except some few men who were out of the station at the time; they all came forward without pressure.

5647. Have you any figures for making a comparison between the uninoculated and the inoculated ?—No.

5648. How soon did these cases occur after inoculation ?—I think a few of them occurred one or two days afterwards. They were cases of children ; two infants were among the number.

5649. Were you quite sure that these died of plague ?—Yes, I was quite sure of them.

5650. Was there very much plague in the town at the time ?—One of the bazars was full of it, the large bazar.

5651. Have you any means of judging whether inoculated people died in less proportion than the people in the town ?—I think in about the same proportion, as far as I could see from accounts.

5652. How was that determined; you took the average mortality in the town ?—I did not work out any figures, but judging roughly.

5653. We want something a little more definite than that. I suppose you can ascertain how many died in Belgaum during that time. Are there any registers kept ?—Yes.

5654. You have no special knowledge beyond what you saw in the papers ?—That is so.

5655. And that was the basis of your comparison ?—Yes.

(Witness withdrew.)

Lieutenant-Colonel E. Lawrie, I.M.S., recalled and further examined.

5656. (*The President.*)—We want to trouble you for a little more information ?—Certainly.

5657. (*Prof. Wright.*)—I understood from you yesterday that you did not think this method of going into a room or house and testing it off-hand by means of a microscope, as to the presence of plague, is valuable as a method of determining whether a house is infected ?—I did not say that at all. We no longer use it because we think it is unnecessary. Where we find plague in a village we at once thoroughly disinfect the floors of the whole of the village.

5658. We had it from Dr. Mullanah that he did not think one could detect plague in a house by going in and taking a sample of earth, and putting it under the microscope : is that your opinion ?—My opinion is that you can. Of course, I mean I should not take what anybody else says. I should trust to myself.

5659. Is your method of examining plague on the ground the same as that described to us by Mr. Stevens ?—It is essentially the same.

5660. You take a little earth, I understand ?—Yes, and make a watery solution and strain it.

5661. I understand that you say that in some cases one would find bacteria, and in other cases no bacteria would be found : is that your experience, or did you always find bacteria ?—What I first went upon was true rod-shaped bacilli ; but I have found since coccoid forms which might be called cocci, or they might be called bacilli.

5662. In every case it is not the mere presence of bacteria that you would go upon ?—No ; it is the particular appearance I showed in this Report,* which I could show you here now.

5663. You think that there may be bacteria found in the floors of houses, which may not be plague bacteria, but you think also that in certain cases the bacteria which are found would have characteristics which would enable you to determine that they are plague bacilli ?—I should act upon that, and verify it by cultivation afterwards. I should think it is perfectly workable as a basis.

5664. Have you examined any earth that came from houses where there was no plague, and have you in such earth found these forms which you consider characteristic ?—No.

5665. Have you made many examinations of earth from houses where there had been no plague ?—I have not done it elsewhere : I did it in infected villages.

5666. I presume for "controls" you ought to have employed earth which could not possibly have contained plague : why in view of this have you not examined earth from villages in which there has been no plague to see whether these bacterial forms appear there ?—I have examined earth from many houses where there have been none of these appearances at all.

5667. Have you examined many samples of earth ?—No, I have not examined many. When we finished with the plague examinations of the floors in the villages, we came here and did cultivation experiments with earth sent in from the villages.

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* See Appendix N . XVIII in this Volume.

Lieutenant-Colonel E. Lawrie.

20th Dec. 1898.

5668. Has Mr. Stevens examined a good number of samples of earth?—I believe he has examined a number of samples of earth from houses which were not supposed to be infected.

5669. I mean has he examined samples of earth taken from villages where there was no plague before, and where there could be no suspicion of the presence of plague?—Yes; I think he has.

5670. I think you have a second method of detecting plague, that is, by inoculating earth under the skins of rabbits?—We did that because we had not any laboratory out in the villages. We did that as a further test to see what effect this earth in which we said the plague bacillus was found had on animals in which it was inoculated.

5671. Do you think that is a more certain method than direct microscopic examination?—It was *merely* confirmatory.

5672. Would you advise these as methods of determining whether the infection of plague was or was not to be found in a house?—I did not advise this second method at all. We did it to confirm our original observations.

5673. You do not then put this inoculation method forward as a practically useful method?—Yes, the first is. The second would be useful to confirm, as it did with us.

5674. Coming to the question of Haffkine's vaccine, we had evidence yesterday from Dr. Mullanah that all the samples of bottles he examined were contaminated?—Yes.

5675. I understand that this is the reason why you do not use this vaccine?—Yes. I would not use a fluid containing putrid or pathogenic organisms for inoculation.

5676. Have you considered the possibility of using it after sterilising it yourself by heating it three times to 60°C?—We used some sterilised fluid prepared by Dr. Mullanah. It was sterile, but we did not think it had any effect against plague, and we did not use it any further.

5677. Have you tried Haffkine's fluid after sterilising it?—No.

5678. Do you think it would spoil the effect of the vaccine to sterilise it?—I would not like to give an opinion about that without making experiments.

5679. In this vaccine of Haffkine's, you say there are dead plague bacilli?—No, I never said there were.

5680. Do you know what Haffkine's fluid contains?—I have seen micrococci, and I have occasionally seen bacilli in Haffkine's fluid.

5681. You have found it to give protection against plague: do you infer from that, that it contains dead plague bacilli, or the poison of plague bacilli in it?—No, I do not infer anything.

5682. How do you explain the immunity you get by it?—I cannot explain it. I only state the facts.

5683. Do you not think that the fact that you get immunity against the disease by the injection of a fluid which is said to contain dead bacteria points to the fact that the fluid really does contain such bacteria?—You do not get immunity in every case with Haffkine's fluid. In a certain number of cases you do; but you do not get anything like universal immunity. That is, judging by my own experiments.

5684. In the case of rabbits, I think you told us you found a considerable amount of immunity?—I would not use the word "immunity."

5685. Will the word "protection" do?—I will go so far as to say that when it is injected in large doses it affords a great amount of protection against subsequent inoculation with plague; but the immunity or protection is not universal: we have had cases in which plague has occurred.

5686. It is not an absolute immunity, I am quite aware; but such immunity as you get, do you ascribe that to the contaminating living micro-organisms which you have found to be present or to the poison of the plague?—I would rather not give an opinion upon that, because I am not certain of it at all. I would rather not state anything that I do not know to be a fact.

5687. (*The President.*)—Have you made any experiments to confirm that?—We have made experiments, but we have not arrived at a final conclusion.

5688. (*Prof. Wright.*)—You do not recommend the use of this vaccine?—Not after I have seen what is in it.

5689. But you could easily get rid of that living bacteria. Supposing they were got rid of by sterilisation, would you then approve of its use?—I would approve of injecting it as a sterile fluid, but whether it would give protection or not I do not know.

5690. You have no experiments made to determine that point?—No.

5691. You have no experiments which show that if it was sterile, it would give protection?—No, not yet.

5692. If you could only eliminate the living bacteria and not alter the composition of the fluid?—If you heated it enough to destroy the micrococci, I do not know whether you would not destroy everything else in it.

5693. The fluid has already been heated to this temperature?—No, it has not. It has only been heated to a temperature of 65.

5694. Supposing you heat it again to 65, you would then not alter it in any way except killing the micro-organisms?—I do not think we should kill all the micro-organisms in it. I am told that temperature kills plague bacilli. I do not know that it kills the other micro-organisms which we find in it.

5695. Do you know that Tyndal recommends, as a method of sterilisation, the heating of the material three times to 65°?—No, I do not.

5696. Do you know this method is an effectual method which is used in every laboratory?—I would not rely upon it in the hospital.

5697. Are you aware that it is relied upon as an effective method of sterilisation in every European laboratory?—I am not aware of that. We rely upon nothing less than prolonged boiling at a temperature of at least 300 F.

5698. Are you not aware that this method is used as a method of sterilising serum, that it is used, for instance, in sterilising anti-toxic serum?—No, I am not. It is a point I have given no particular attention to. I certainly would not rely upon heating to 60 only in surgery.

5699. If the fluid was rendered sterile by that method, would you have any objection to using it?—Not if I were sure that it was sterile.

5700. If that ground were removed, would you still object to using it? Have you any other grounds for objecting to Haffkine's vaccine? Supposing the vaccine were rendered sterile, would you then still object to its use?—I should not object to it.

5701. Do you anticipate that the vaccine would be useful if that were done?—I do not know: I can give no opinion about that without further experiments.

5702. You do not think your experiments are sufficient to enable you to determine that point?—No, certainly not.

5703. Is not the only other possible alternative conclusion which you could draw from your experiment, the conclusion that the contaminating micro-organisms confer some immunity; would you think that is possible?—I should think it quite possible,—the same amount of immunity as you find conferred by a mild attack of plague itself.

5704. Do you think that the presence of a few contaminating micro-organisms in ordinary vaccine lymph would protect against small-pox?—No, I would not say that at all.

5705. Supposing I suggest to you the fact that small-pox vaccine contains micro-organisms, would it occur to you that the protection which vaccine lymph gives against small-pox could be due to the fact that it contains these contaminating micro-organisms?—No, certainly not,—not as a protection against small-pox.

5706. It would not occur to you?—I have said no.

5707. But it does occur to you in the case of Haffkine's vaccine?—It is possible: but it has not been confirmed by experiment. We have tried micro-organisms by themselves, and they do not give the same immunity as the fluid does. I can say that much positively.

5708. Do you not infer from that, that the fluid from which the micro-organisms have been eliminated is the thing that gives immunity?—No; I do not, because these micro-organisms appear to give a certain amount of immunity. I should require a great many more experiments before I form any opinion upon it. It is a point we are now working out.

5709. If this fluid were given to you in a sterile form, you would not at present have any objection about it?—No.

5710. You think that it would then be quite right to try whether it gave protection against plague?—I would not take anybody's word for it that it was sterile. I should examine it myself, and I should not consider it right to use it in man until it had been thoroughly tested in animals.

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5711. Then you would use it?—Yes, then I would.

5712. Would you recommend its use in an epidemic of plague?—I would not at present. With my present knowledge I should require a great many experiments made with a fluid you say is sterilised to see what effect it has. I should like to explain to you the list of experiments Dr. Mullanah was asked about yesterday,—the control experiments.

5713. (*The President.*)—I understand that you can give some further explanation in regard to the reasons why those experiments have been marked "control" experiments?—When we did these experiments with inoculation we did a certain number of experiments with other putrid fluids to see what their effect was as compared with the inoculations with the scrapings from the floor earth and with cultures made from the animals, and other cultures that we had prepared in the laboratory. That is to say, the first point that occurred was this; it was said that the inoculation of the floor scrapings, the watery solution of the floor scrapings, might itself produce, for instance, peritonitis, and the first of what we call the "control" experiments, to see whether this was so or not, was to see what other substances might cause peritonitis, and we inoculated in the peritoneum with putrid urine. That was simply marked No. 1 as the first of those experiments, and they were numbered as "control experiments" in that way. This Report* was not prepared for the Commission; it was simply a Report sent up to the Nizam's Government. When the Plague Commission was coming here, I made a resumé of all the experiments, and in order to simplify the numbering all the rabbits were numbered according to the dates upon which they were operated,—Nos. 1, 2, 3, 4, and so on.

5714. It is a chronological sequence?—Nothing else. Even the original experiments were not done on the same dates as the inoculation experiments with the plague earth, and from animal to animal.

5715. (*Dr. Ruffer.*)—You made "control" experiments with sterile pus; that one was done with sterile beef broth?—Yes.

5716. What was the object of that experiment—I did not quite gather from the evidence yesterday?—The pus was sent up from the hospital as pus from a liver abscess, and we inoculated with it, among other fluids. That is all.

5717. There was no special reason?—No. With regard to inoculation with pure broth, when Dr. Johnston came down to help us with the experiments, he said "Have you made an inoculation with the pure broth, because people might say that the broth itself had some effect upon the rabbit?" We therefore made this inoculation with pure broth, which was done a long time after the experiments were begun, on the 9th of July.

5718. (*The President.*)—Dr. Wright referred to a point and suggested that you might use the prophylactic fluid if it were rendered sterile by heating three times to 60 or 65. I understand you to say you are willing to use it as a practical measure, provided, in addition, you have experimental evidence that it retains a prophylactic power, or possesses a prophylactic power. You are waiting for that experimental evidence?—Certainly.

5719. (*Dr. Ruffer.*)—I must ask permission to take you again on to a subject we have discussed before, but I am not clear about it: it is with regard to your letter No. 2156 of 1898,* where you say "Accordingly the infection in the shape of this microbe was tracked about, by means of the microscope, from house to house in the infected villages;" and further on you say "The infection of plague can be tracked about by means of the microscope with as much certainty as if it were visible to the naked eye." I take it from your evidence that what you would consider as characteristic under the microscope are the cocci and the bacilli showing bi-polar stainings: is not that so?—I have never said anything about taking cocci as a characteristic.

5720. Bi-polar staining?—I take bi-polar staining as one only of the characteristics of the plague bacillus.

5721. What are in your opinion the characteristics of plague earth?—You will see them in the original Report of the 8th of March sent in from Ganjoti.* *This* is the sort of appearance I went on first.

5722. These streptococci, are they bacilli?—It is the standard photograph of the plague bacillus. That is what we took as the standard when we began our work.

5723. Is it not a fact that bacilli of this shape are frequently found in all sorts of things?—I should think bacilli of the same kind; in appearance you mean.

5724. In morphological appearance?—Quite so.

5725. They are found, for instance, in water, are they not?—I have never found them in water myself.

5726. In mud?—I cannot say from any examinations of my own.

5727. But you will allow they are very frequently found in nature in various places?—I do not know that they are. I do not know that bacilli of that plague form are found frequently.

5728. I should have thought they were found most frequently. Why is this put forward as a standard photograph of the plague bacillus?—It is used in the text-books as the standard. What are you to rely upon when beginning an investigation? It is put forward as the standard, and is accepted by the profession as a standard.

5729. Supposing you found this kind of bacillus in earth, how can you tell by the microscope alone that it is the plague bacillus?—I should form an opinion that it is the plague bacillus, and then confirm it by inoculation and by cultivation.

5730. I take it that without further inoculation and cultivation you cannot say it is the plague bacillus?—I could not say positively: I could only form an opinion. Inoculation and cultivation showed us that the bacillus which we tracked about from house to house by means of the microscope is the true bacillus of plague. The same appearance in floor earth would enable us to track it about again in the same way.

5731. You could not say positively: then you cannot possibly track the bacilli under the microscope from house to house?—I have modified my opinion a great deal since I did culture experiments. You will find in my Report* that I have not modified my opinion without stating it. As a working basis I still adhere to it. You can track the plague bacillus about if you want to do it by means of the microscope.

5732. Do you say that this form of micro-organism may be found frequently in nature?—I do not know that it is. I have not found it in anything else at all except in plague earth: but I have not done very much work of that kind.

5733. Would you kindly turn to the photographs of Mr. Stevens: * there is one thing I should like to have explained?—I think it would be better to ask Mr. Stevens about his own photographs. I shall be very happy to state anything I know.

5734. In Figure III (fresh agar culture of five hours' growth of plague bacilli found in the blood of rabbit No. 7, series 1, *post mortem*) you will find a photograph of a rather short, slender bacillus?—Yes.

5735. It is magnified 550 times?—Yes.

5736. If you turn to Figure IX (a fresh preparation of bacilli in the peritoneal fluid of a mouse that died of plague in the Pasteur Institute, Paris), you will find a very short bacillus which is magnified 1,200 times. It is certainly shorter than No. III, and two or three times as stout?—Yes.

5737. No. IX is the standard bacillus?—Yes.

5738. If you compare No. X, "Fresh specimen of the plague bacillus found in the floor scrapings of an infected house at Akola (multiplied 1,200 times)" with No. III, I think you will allow that there are considerable differences between the two?—So there are differences between the different plague bacilli themselves. That is one of their characteristics.

5739. Are there very considerable differences?—Yes.

5740. Are there not very considerable differences between No. II, for instance, and No. IV?—Yes.

5741. And between No. II and No. I?—Yes, there are differences in size: certainly. Is it not accepted that there are differences in size about the plague bacillus itself, just as much as there are in the photographs?

5742. Is that your explanation?—I would not give any explanation of it. I say there are differences in the size of the plague bacilli themselves.

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5743. Quite so. In the diary of Mr. Stevens, condensed by the Plague Commissioner from the daily reports* there are a few points I should like to ask a few questions about—the experiments made on June the 5th, 6th and 7th. You say that you made sub-cultures: "Two broth cultures were made from the cultivation of the preceding day." I suppose the cultivation was a mixed cultivation in that case?—That I cannot recollect, but Dr. Mullanah will give you positive evidence about that. I believe, as a matter of fact, it was: but I cannot say positively.

5744. On June the 15th you say,—" A full-grown healthy abbit, No. 1, was inoculated in the peritoneum at 10 A.M. with 5 c.c. of a solution of earth in sterilised water from Hunia dyer's house"?—Yes.

5745. Then you have a series of experiments in which new abbits were inoculated from this and from another rabbit nfected from a second house. I think I am right in tating that this first rabbit died in less than 24 hours?—Yes. The times are stated. The first rabbit died the next day, I suppose it must have been less than 24 hours.

5746. The second one in six hours?—Yes.

5747. The third one in about 12 hours?—Yes.

5748. The fourth in three days?—Yes.

5749. The fifth in 12 hours—Yes.

5750. The sixth in 12½ hours; the seventh in 24 hours, but he was twice inoculated. " A very large rabbit, No. 7, was inoculated with a small dose of 20 minims of broth culture four days old from rabbit No. 5 at 10 a.m. Its temperature was then 102°; by 6. p.m. it had risen to 104°. A photograph was taken of a characteristic field of plague bacilli from a 24 hours' culture from the blood of rabbit No. 6. The rabbit inoculated on the 5th was again inoculated on the evening of the 6th; its temperature was 104°·2 on the 5th, 105°·4 on the 6th, and 106°·2 on the 7th, when it died at 8-30 a.m." So that it died 24 hours afterwards?—Yes.

5751. The eighth died in 72 hours, the 9th and 10th in two days and four days, respectively?—Yes.

5752. Before I proceed any further, I should like to ask you about rabbit No. 2, which died in six hours. Have you ever seen any septicæmia, however acute, kill an animal in six hours?—I cannot say I have ever seen it happen in an animal. I have made no experiments with reference to septicæmia, except what you see here. I never have.

5753. The animals all died within three days, and they died in periods varying from six hours to four days; all of them except two died before four days?—Yes.

5754. If you turn to your "control experiments," in the first lot of experiments handed in by your assistant, you will find in the "control experiments" with plague bacilli, which I believe you got from a plague patient, the first animal died in three days, the second in three days, the third in four days, the fourth in seventeen days, the fifth in eight days, the 6th in eight days also, the 7th in four days, the 8th in five days, the 9th in one day, the 10th in three days, the 11th in four days, the 12th in two days, the 13th in four days, the 14th in two days, the 15th in six days; then you have a whole batch which died between four and seven days; and the 17th in four days?—But is not that including rabbits that were protected as well?

5755. No, they were "controls"?—But then it includes rabbits inoculated subcutaneously as well as those who were scratched.

5756. No; those that were scratched I left out. I may be wrong, but that is my impression?—Yes.

5757. If you compare the two sets of experiments, you will find in the second set out of something like 24 rabbits only two died in less than three days; in the first set of experiments out of ten rabbits all but two died in less than four days: so that there is a considerable difference in the length of time in the two sets of experiments?—That is all stated in the Report.*

5758. As a matter of fact, the animals which you inoculated with plague from a plague patient took very much longer to die than those you inoculated from the earth?—That is shown in the Report.* There are differences in the way in which the inoculation was done. In the first set of experiments, I cannot say in how many cases, it was done in the peritoneum. As far as I can recollect, I do not think any of the inoculations were done in the peritoneum, certainly very few. Then there is a great deal of difference, of course, in the comparative dosage, and there may be a very great difference in the virulence of the material that was inoculated.

5759. In the second dosage you used very large doses, as much as 3 c. c. of plague, which is an enormous dose. Even 1 c. c. of plague would be a large dose. Those surely would be enormous doses?—We used enormous doses purposely. We wanted to produce very definite effects.

5760. But in spite of that the animals died in a very much longer time than in the first set of experiments?—But in the first set of experiments large doses were used. It was a solution exactly like a solution of culture: we did not know which were the strongest.

5761. What then is our explanation of the difference?—That may be a possible explanation. There was a great difference in the way in which the experiments were done, and also there may have been great differences in the virulence of the material injected. The quantity, 1 c.c. or 3 c.c., injected only shows the amount of fluid in which the virus was conveyed, not the amount of the virus itself. There is that much uncertainty about them, that you do not know precisely what the dose of the virus was in any case.

5762. Under the date of June 17th in the condensed diary* I find " As it was clear that the plague bacilli remain, in the first instance at all events, on the surface of the medium only, the scum was taken from the blood and the liver cultures." Do you mean to say that these bacilli formed a scum on the surface: did they form a membrane?—That is an opinion upon Mr. Stevens' experiments. It is condensed by me in a form. I cannot be responsible for that at all. That is a statement made on Mr. Stevens' own experience.

5763. I draw your attention to this. Just before the passage I have quoted you say,—"No micrococci were present; the organism was pure plague"?—Yes. That is June 16th.

5764. Then under June 19th you say,—" Almost all the cultures from rabbit No. 1, were found to contain micrococci?—Yes.

5765. Surely there is a contradiction between these two things?—But that is on a later date. I cannot be responsible for that. It is a statement by Mr. Stevens or Dr. Mullanah.

5766. Anyhow there is a difference between the two things, a contradiction?—I do not see there is.

5767. If micrococci were not present on June the 16th, they could not have appeared spontaneously in the cultures on the 19th?—They might have been contaminated.

5768. They must have been present in the organs from which you made cultures?—They can explain that. On the 16th of June I fractured my arm and was laid up in bed till the 22nd. At the examination of the cultures from the first rabbit made on the 19th of June there was a difference of opinion between Dr. Mullanah and Mr. Stevens, which I was unfortunately not present to settle as to whether certain microbes were cocci or bacilli. Mr. Stevens' opinion was recorded; Dr. Mullanah's was not. Mr. Stevens wrote as follows; " Almost all the cultures from the first rabbit were found to be contaminated with cocci, probably from careless handling." It does not appear to me that there is necessarily a contradiction.

5769. A little further on you say,—"The cultures from rabbit No. 2 (which had died six hours after inoculation with a broth culture from rabbit No. 1), gave uniform results. A few micrococci were found mixed with an almost pure culture in the peritoneal fluid and liver." If you go back to No. 1, you have a further contradiction which I am unable to understand. On June the 23rd you say,—" The various cultures were examined. Those made on the 16th of June, from the blood of the first rabbit inoculated with a sterilised watery solution of floor earth from Hunia dyer's house, contained a pure growth of bacilli exactly similar to those met with in the original floor earth preparations." That does not correspond with the notes of June 16th or of June 19th?—But then you do not know which colonies you picked out. You had better ask him about that.

5770. You do not know the reason for this discrepancy?—There is no discrepancy that I can see. You do not know which colonies these refer to. There is not necessarily any discrepancy at all. Dr. Mullanah made these cultures. During this fortnight I was absolutely laid up and could only give orders from bed.

5771. He says,—"No micrococci were present; the organism was pure plague." Afterwards he says he found micrococci and a pure growth of bacilli?—Wherever he says that, you may depend upon it that the description is accurate.

5772. Then on June 19th he says,—" The cultures from rabbit No. 2 (which had died six hours after inoculation with a broth culture from rabbit No. 1) gave uniform

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* See Appendix No. XVIII in this Volume

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results. A few micrococci were found, mixed with an almost pure plague culture in the peritoneal fluid and liver. On the other hand, the cultures from the blood and spleen consisted entirely of plague bacilli. In the preparations made on the 17th instant direct from the cadaver of rabbit No. 2 plague bacilli had been found in the peritoneal fluid and in the axillary glands, but none had been detected inthe spleen, blood, or liver" ?—Yes.

5773. A little further on you say,—"Broth cultures. A few large oval bacilli were found at the bottom of the broth cultures, some of the former polar-stained." Were those large oval bacilli considered as plague or not ?—That I cannot tell you. I fancy they must have been; but Dr. Mullanah can tell you about that.

5774. A little further down you say,—"Examinations were made of all recent cultures" ?—Yes.

5775. Could you tell me how these examinations were made ?—I think you had better ask Dr. Mullanah about that. They were made by him.

5776. Then you say,—"In some of the older cultures many involution forms are to be found." How long was it before you found involution forms ?—I cannot tell you.

5777. A little further on, on July 10th, you say,—"No circular or involution forms were present"—that is in a culture which I take to be two days old. I would also point out something which I cannot understand in the notes for July 14th ?—After the 7th of that month all the statements that are made here are made on the authority of Dr. Mullanah and Dr. Johnston.

5778. On July 14th you say,—"At 4-30 p. m. a healthy rabbit, No. 9, was subcutaneously injected with 0·5 c. c. of agar plague culture in sterilised broth, and a second rabbit No. 10, with 3 c. c. of the same culture." Therefore rabbit, No. 10 had six times the dose of No. 1. Rabbit No. 1, which had a smaller dose, died on July 16th ?—Yes.

5779. Rabbit No. 10 had six times the dose, and was alive on July 16th: it only died on the 18th. Is that a mistake in writing out the experiment, or is that experiment right ?—I think you must accept that as correct. I do not think there is any mistake.

5780. I asked Mr. Stevens yesterday why he did not disinfect the walls of the houses, and he said he had been told by the Plague Commissioner that the walls of the houses did not contain the virus ?—Yes, but I think you will find in most cases the walls were disinfected: it was part of the rule.

5781. It does not appear from the papers which have been handed to us ?—I think you will find it is the case. It says here,*—"In none of the cases in which we examined did we find the plague bacillus in dust or scrapings of roofs or walls of any of the houses examined." Again, it says,—"The infection of plague is confined to the floors of the houses, but as a precautionary measure the lower part of the walls of the houses may be scraped and the scrapings burnt with the floors." And then in the kiln method of destroying infection, we said positively that the surface of all floors and the lower portion of the walls two feet from the floor surface is first to be painted over with rather a thick lime-wash and allowed to dry, and then burned.

5782. You only disinfect the walls up to two feet ?—Yes.

5783. Why not disinfect the whole wall ?—I do not think there is any chance of the wall being infected except from spitting.

5784. No doubt it might be infected by expectoration, and might it not be infected also through dirty clothing being placed against it: is that not possible ?—It is possible.

5785. Do you not think it would be a better measure to disinfect the whole of the walls ?—I think probably it would be. I think we might with advantage alter that rule, to have the whole of the wall disinfected the same as the floor.

5786. (*Mr. Hewett.*)—I understand you to say that only suspicious persons travelling by railway are stopped at Inspection Stations ?—Yes.

5787. Other persons who are not regarded as suspicious are allowed to proceed to Hyderabad ?—Yes.

5788. Can you provide us with the figures from the 1st of October showing the number of persons examined, the number of persons detained, and the number of persons who developed plague at each place ?—Yes; we can give you the full figures.

5789. I think we might have them for the last quarter of the year ?—You can have them since February 1897. (The witness subsequently supplied figures as follows†:—)

Statement showing the number of "suspicious" passengers detained under observation at Wadi, Gulbargah, and Raichur during the latter half-year of 1897 and 1898.

NUMBER OF PASSENGERS DETAINED UNDER OBSERVATION.			FEVER CASES.			PLAGUE CASES.			DEATHS FROM IMPORTED PLAGUE.		
Men.	Women.	Children.	Men.	Women.	Children.	Men.	Women.	Children.	Men.	Women.	Children.
35,534	7,942	4,152	141	19	3	16	1	...	14	1	...

5790. (*Dr. Ruffer.*)—Have you any personal evidence as to the motility or non-motility of your plague bacillus ?—That is one of the points about which there was a difference of opinion. Some of us thought there was motility in the bacillus, others thought there was none.

5791. Did you ever notice anything resembling capsules in the bacillus found by you in earth ?—No. That was a point about which there was a difference of opinion. Dr. Mullanah called my attention to it one day. He said he thought the bacillus was capsuled, but I could not see any trace of a capsule. We never found in any preparations of the plague bacillus any sort of a capsule.

5792. Nor in those that come from patients ?—Not in any of them.

5793. (*The President.*)—To make it quite clear, in these preliminary examinations of a microscopic character I understand that all the information you endeavoured to obtain was to find something which on further examination would show you it was plague bacillus, or was not plague bacillus ?—Yes.

5794. That is all ?—Yes. I should like to make one further statement, namely, since the Commission met yesterday a rabbit has died, which was inoculated with floor scrapings from an infected house in the Kobpal jagir. That rabbit has died of plague, and the plague bacillus has been found in its blood and, I think, in the spleen. The rabbit was inoculated with earth which Mr. Stevens himself got from an infected house in the Kobpal jagir. It was inoculated on the 15th at 7-30 a.m., and it died on the 18th at 4 p.m.,—three days.

5795. (*The President.*)—When was the last plague case in the house, Mr. Stevens ? (*Mr. Stevens.*)—The village had been evacuated three weeks before I took the scrapings of the earth. I came to Hyderabad four days after I had taken the earth out of the house. The earth had been in a small glass tube four days before it was inoculated, and the house had been evacuated for three weeks before I took the earth from it.

5796. (*Dr. Ruffer.*)—Have you any evidence to show how long plague bacillus artificially introduced into earth can live ?—We have some, but that is a point we are making experiments on now. I can produce what there is up to date if you call for it.

(Witness withdrew.)

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* See Appendix No. XVIII in this Volume.

† Regarding this see Lieutenant-Colonel Lawrie's re-examination on the 20th of March 1899.

CAPTAIN CHARLES A. JOHNSTON, I.M.S., recalled and further examined.

Captain Charles A. Johnston.

20th Dec. 1898.

5797. (*The President.*)—We want to ask you for further information with regard to some of your experiments?—Yes.

5798. (*Prof. Wright.*)—You have some data for determining the question whether living micro-organisms have been found in Haffkine's prophylactic fluid: would you describe the experiments you have done? To begin with how did you obtain the prophylactic fluid you tested?—The bottles were sent up from Bombay from the Haffkine laboratory. I do not know the exact date they were received here. I manage to come down twice a week to the laboratory. The bottles were there.

5799. Were the bottles dated?—Every one of them. The receipt of the bottles here is dated. There is a regular record kept.

5800. (*The President.*)—Will you be good enough to supply us with the dates?—Yes. (The dates supplied by witness for bottles received up to the date of his examination are as follows):—

Dates of arrival of Haffkine's Fluid at Hyderabad.

No.	4168	received at Hyderabad	on	19th November 1898.
,,	3962	,,	,,	20th October 1898.
,,	4096	,,	,,	,, ,,
,,	5324	,,	,,	16th December 1898.
,,	5338			
,,	5349			
,,	5315			
,,	5344			

5801. (*Prof. Wright.*)—Were the bottles examined to see whether they were securely sealed?—I examined all I had inoculated on agar culture tubes. I examined all the bottles myself. In the case of any doubtful bottles I did not pay much attention to the result.

5802. Were the bottles chosen by any special method or taken at random out of a series of bottles?—The bottles were taken at random out of the different series. The last experiment we did in your presence.

5803. Were these bottles you tested selected from various brews?—They were selected from a lot of different brews. Six were selected from nine different samples.

5804. Will you describe what steps you took to ascertain whether there were micro-organisms in that?—I got agar slant tubes—8 slant tubes, two were used as "control" and the other six were inoculated with Haffkine's fluid from six different brews which were prepared in Haffkine's laboratory. The bottles before being opened were examined, the sealing-wax was examined, and the necks of the bottles were examined to see if there was any means of contamination by external air. All those bottles which were properly sealed were chosen,—there were six of them. Six different sorts were chosen. On opening the bottles, the mouths of the bottles were sterilised by heat in the flame: sterilised forceps were used to extract the corks, and the necks of the bottles were well sterilised by placing them in the flame. A certain amount, perhaps 10 or 15 minims, of fluid was then poured into the agar slant tubes. They were then left in this condition to grow at the natural temperature of the room. This morning I see that everyone (except one which is a bit doubtful) shows a growth of living organisms.

5805. Could you detect is by smell that any of these bottles had gone wrong?—There is a faint odour of putrefaction in most of them: but in this last experiment I did not smell them in case there might be chance of extraneous organisms dropping into the fluid during the performance of this experiment.

5806. We have it on record that all bottles having a distinctly putrid smell were not used. Would these bottles have come under that head?—I should think so. Some bottles do not have any smell at all, beyond the faint smell of bouillon.

5807. Are these then bottles which would have been used?—I did not detect any putrescent smell in them. I only detected the ordinary smell of bouillon.

5808. (*The President.*)—They would have been used?—Yes, I think so. They would have been used in this laboratory for experimental purposes. Every one of them would have been used in the laboratory, but whether they would have been used for the inoculation of patients, I do not know.

5809. (*Prof. Wright.*)—Could you show us the tubes?—Yes, I have them here. (Tubes produced.) *These* are the two "controls" of the same agar made at the same time. *That* is one of them; and *here* is another.

5810. (*Dr. Ruffer.*)—Have you got sub-cultures of these?—I have not had time. I had only just seen them. *This* is a doubtful one. I think there is some wool in this besides organisms. It is a growth I think. The others show the most beautiful growths of living organisms.

5811. (*Prof. Wright.*)—You tested six bottles, and you say five of them showed a distinct growth, and the sixth is a little doubtful?—In five there are undoubted growths of living organisms,—the sixth is a bit doubtful at present. It is only 36 to 48 hours now.

8512. (*Dr. Ruffer.*)—How much did you inoculate in each tube?—I had no set quantity.

8513. Could you tell us the quantity?—You could see it in the fluid. In some cases only ten drops, and in others there is as much as a drachm.

5814. (*Prof. Wright.*)—In some cases you take it out with a platinum needle?—Yes, in some cases. In only one case did I take it out with a platinum needle.

5815. You say that one was inoculated with a loop full from a platinum needle?—Yes.

5816. The others had varying quantities?—Yes.

5817. What quantities?—Varying from 5 to 40 minims.

5818. (*The President.*)—In the case of the doubtful one how much?—About 30 minims. I think myself the doubtful one is really growing.

5819. (*Dr. Ruffer.*)—How did you pour the drop of fluid from the bottle into the tube?—Both of them on the slant after heating the neck of the bottle containing Haffkine's fluid, and the mouth of the test tube. I poured it in on the slant.

5820. *Prof. Wright.*)—Did you flame the mouth of the bottle and the mouth of the test tube?—Yes, both.

5821. (*Dr. Ruffer.*)—It would be interesting if you would complete the examination of these tubes?—I will do so.

(Witness withdrew.)

Mr. A. H. STEVENS recalled and further examined.

Mr. A. H. Stevens.

20th Dec. 1898.

5822. (*The President.*)—We want a little more information from you. You gave us particulars yesterday as to the nature of the method you employ?—Yes.

5823. How many different districts were infected?—I think it would be clear if I pointed it out on the map. The first infection in the last cold season was in 8 districts, those 8 districts were in four tracts; the first tract was Palaskira on the Khandesh border; the second was Dalabadgaon on the Ahmednagar frontier.

5824. I think you gave us this yesterday. Kindly tell me how many?—Fourteen talukas was infected, *viz.*, Naldrug, Taljapur, Paranda, Ganjoti, Nilanga, Alland, Kalliani, Kurthabpur, Yelburga, Kopbal, Kushtagi, Mudgal, Ajanta and Bhir.

5825. How many had you round Sholapur?—There were three districts round Sholapur. The Naldrug, Taljapur, and Paranda districts are all round Sholapur.

5826 What is the population of the districts infected there?—The population of the villages round Sholapur varied from 2,000 to 500.

5827. What would be the maximum population?—2,000.

5828. What was the total number of cases for that particular area?—I could not give that without separating the districts.

5829. I suppose there are several hundreds?—Yes, I should say 500 last year.

5830. Were the measures you adopted successful in eradicating the disease from this part of the district?—Certainly. I think the proof of that is that although the plague came in a great number of different districts, we never let it advance beyond a certain distance inland. By looking at the map you will see that at the outside it never got more than 60 or 70 miles beyond the frontier. We have had plague now for over twelve months, but we have always stopped it within measurable distance of the places at which

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it started on the frontier. It has not spread inland in the Nizam's territory.

5831. It was absolutely eradicated in these places?—Yes.

5832. Did it ever re-appear?—Only in the one village I mentioned yesterday. I must put in a telegram which I received last evening when I went back. The telegram is dated the 19th December and comes from Kopbal. It was despatched on the 19th instant at four minutes past ten. It was, therefore, probably delivered at my house, when I was giving evidence here. I got the telegram when I got back to my house yesterday evening at 5 o'clock. It is as follows:—"To A. H. Stevens, Esq., Deputy Plague Commissioner, Hyderabad, from D. V. Sarade.—Mazhar Hussain reports Balsoor and Maraj newly infected; total Balsoor, attacks 2, total deaths 3; total Maraj attacks 8, total deaths 5 to 15th December."

5833. Do I understand that this is a new infection or a recrudescence?—If you look at the list of infected villages given in by me yesterday, you will see these villages are numbers 5 and 6.

5834. Therefore a recrudescence?—The telegram says reinfected. It is eight months since the last case occurred there. Dr. Mazhar Hussain will give his evidence with regard to these villages, and he will be able to give you any information you may want. Personally, I know nothing about it. The first thing which I knew was this telegram, which I got yesterday evening.

5835. You told me yesterday that the infection came from British India, in all instances?—Not in all instances, in most instances.

5836. Where you have had recrudescence, has that recrudescence proceeded from your own territory, or from British India?—The only recrudescence, if it can be called recrudescence, is in the case of these three villages of which I know nothing. Dr. Mazhar Hussain has been at Ganjoti. As far as I know the only information I have is what I received last evening.

5837. Had you much difficulty, in preventing an entrance across the border from British India?—As a rule they came into the country before we knew anything about it. Most of our time was taken up in sending them back again.

5838. Even in a district like that adjoining Sholapur, where you have a relatively small line to defend?—Yes. But a great many of them had gone very much ahead of our infected area. For instance in the village of Gulbargah, there were over 5,000 Sholapur people who had gone in and they had extended considerably beyond the line of infection. Fortunately they took no sickness with them. All the refugees cleared out of Sholapur at that particular time.

5839. Have you any definite co-operation with the authorities on the other side of the border to prevent the introduction of plague?—No.

5840. Does it occur to you that any co-operation in any direction might be useful?—I certainly think so, very useful.

5841. In what directions and how?—I think the British Government officials should do everything they possibly can to prevent their people from coming into our country, and I think we ought to do the same. We ought to take the earliest steps to let British Collectors of Districts bordering on the Nizam's territory know if people are running away from our country and in what numbers, and in the same way I think they ought to let us know.

5842. Is it probable that the authorities in a British District would have early information of this exodus from their country?—They ought.

5843. Do you think the machinery which exists is sufficient to give that information?—I think when there is an exodus of several thousands from any village the authorities, whether British or Nizam's, ought to know it.

5844. I infer from what you say that such exoduses have taken place without your obtaining the knowledge?—They have.

5845. I think you told us that you relied very much on burning as an effective measure along with evacuation?—Yes.

5846. Can you tell me why you do not more largely use disinfectants, to what extent do you use disinfectants?—This year we have not used any disinfectants at all. Last year we used perchloride of mercury, because those were the orders. This year I have not used it.

5847. (*Dr. Ruffer*).—You said in your evidence you disinfected two feet of the wall?—That is the scraping of the wall and burning it.

5848. (*The President.*)—That is what you are now trusting to solely?—Yes.

5849. With regard to the walls, how do you deal with them?—We have not touched the walls beyond two feet. When they are white-washing the walls, a line is marked about 2 feet above the floor (it may be a little more) and is scraped off with a hoe. This earth is scraped up to that and burnt with the floor earth. The upper part of the walls we have not touched.

5850. Where there was evacuation and where these measures have been taken, do you remember any instances in which people have gone back to the houses?—Yes.

5851. Are you aware of any case in which plague has recurred in a house thus treated?—I do not know of a single house.

5852. Except those cases which a moment ago you referred to?—Those are not the same houses. I do not know a single house.

5853. To what extent do you consider rats able to introduce or extend plague?—I do not know. I think they may possibly spread it about in a village, but I do not think they could take it outside a village. I have no means at all of being certain they spread it about a village.

5854. You are not sure that they have any influence?—No. The only evidence is that rats generally begin to die before human beings do; but I have no evidence before me that rats have in any way spread plague about. I have no evidence that houses in which rats died were the first houses in which plague broke out: in fact, in several instances where they told me rats died they have never had any plague at all.

5855. What is the machinery for registering deaths in this country?—In the Nizam's country the two village Headmen, the police and the revenue Patel, make a return which is sent in to the Tahsildar (who is the local Revenue Officer); and the Tahsildar sends it to the Talukdar, who is equivalent to a District Collector in British India. This return is kept with the village records. That is the only machinery that I am aware of. When there is plague in a large village we generally put on an extra writer, and we may have people who go about in the different encampments trying to find out whether people have been taken ill, or whether any have died. It is necessary to do this because the camps are scattered, and if there are deaths the people will not come in and report them.

5856. (*Mr. Hewett.*)—What is the largest number of villages you have had infected at the same time?—Fourteen villages.

5857. Can you tell us the largest staff you have had employed on any operations at the same time, approximately?—Military or disinfecting?

5858. I want to find out the number of persons you employed to look after the people who were taken out of their houses?—The largest number we have had in any individual village has been eight Infantry privates and non-commissioned officers. The usual number is four.

5859. Is there any plague, to your knowledge, in the British territories adjoining the taluka of Ganjoti at the present moment?—There is no British territory adjoining Ganjoti.

5860. In the neighbourhood?—The nearest neighbourhood is Sholapur. There is no doubt that the original infection, ——

5861. I am not speaking of original infection. Is there any plague in the Sholapur district to your knowledge?—Yes. I get daily reports.

5862. From whom?—From the Collector.

5863. I understood you to say that you did not get information?—I do now. This is an arrangement which has just been made, quite recently, within the two last months.

5864. Is this the first Collector in the Bombay Presidency you have ever got information from?—About two months ago, with the sanction of Dr. Lawrie, I asked permission to write to all the Collectors in British provinces bordering on the Nizam's territory, and ask them whether they would give me their daily reports in exchange for mine. I did this because the Nizam's officials are not permitted to correspond direct with any British officials. All correspondence

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has to go through the Residency. As this was an emergency case, and a good deal of time would be lost in the reports being sent to the Residency and then filtering through two or three Secretaries before they got to me, I applied for sanction to do this and I received it.

5865. Would it surprise you to hear that the Collector of a district would telegraph regularly if plague broke out?—I never got a telegram.

5866. It is possible that the telegrams arrived but that you never got them?—I never got any.

5867. They would not be directed to you?—No, because I have not got them.

5868. Whom would they go to?—I do not know.

5869. I understood you to make a charge against all British districts that they have done nothing in the way of sending information. I want to know the grounds upon which you make that charge?—Simply that at the time I left Hyderabad, and went out, no information reached me.

5870. Are you an advocate of quarantine?—No.

5871. Would you propose to block people up in one district or one portion of India and to prevent them from going to another?—I think that as far as possible people should be kept in their own villages, but I do not think you could make a distinct line of quarantine.

5872. That is very much the same thing, is it not? You would pen them up in the infected area?—As much as possible.

5873. That is practically quarantine, is it not?—Yes, it is a kind of quarantine.

5874. In your "Memorandum on the method of detecting the presence of plague infection in dwelling houses,"* you say "The appearance of the plague microbe in floor scrapings can be seen in Plates I, X, and X*b*, this appearance is so uniformly characteristic and so invariably present where plague exists;" do you still adhere to the opinion that it is invariably present when plague infection exists?—Certainly, as far as my unscientific knowledge goes. I was shown a certain appearance in the floor earth which I was told was indicative of plague, and wherever I have examined floor earth I have found a similar appearance, and I have no reason to alter my original opinion.

5875. You adhere to that view?—Yes.

5876. In another place in your "Memorandum on the treatment of plague-infected premises and the destruction of the infection by the kiln process of burning",* you say—"It having been authoritatively decided that the infection of plague is to be found on the surface of the floors of houses occupied by persons suffering from plague, the destruction of the infection is the first object to be aimed at." You mean authoritatively decided by these experiments in which you have taken part?—I looked upon it as the decision of my official superior.

5877. What authority do you mean?—Dr. Lawrie, the Plague Commissioner of Hyderabad.

5878. (*Dr. Ruffer.*)—I suppose the system of evacuation which you speak of could only be applied when the weather is fine?—I think on black cotton soils—on clay soils, it would be almost impossible, at least for two months of the year, to evacuate villages. I think, however, on high rocky sites or high sandy land it would be quite possible to evacuate in the rains.

5879. But are you of opinion that in a great many cases evacuation would not be possible for two or three months in the year?—Certainly not on black cotton soil.

5880. Could you tell me what was the average duration of plague in the villages in which you tried your new system of disinfecting houses?—It varied much.

5881. Could you give us some figures showing for instance the shortest and the longest duration of plague in a village which had been so disinfected? I take it that you claim certain advantages for this method: I should like to compare your figures of the time which you took to stamp out the epidemic in a village treated by your method, with figures relating to other villagers treated by another method. I take it that, if your method is superior, plague should be stamped out in a shorter time?—Yes.

5882. Could you add such figures to your evidence?—Yes.† I should also like to explain that I do not think the number of deaths in any particular village is very much of a guide because in some villages we have had over 100 deaths before we knew there was plague there at all, small villages, say, of 600 inhabitants; whereas in the case of large villages of 1,500 or 2,000 inhabitants, when we have got prompt information, we have never even got up to 10 deaths,—there may have been 8 or 9 deaths. We have evacuated the village at once, and the thing is stopped.

5883. We want to know that, but there is no information as to that in your précis of evidence. You claim certain advantages?—I may mention the extreme cases of two villages mentioned in the list of infected villages which I gave yesterday. Kajuri and Katgoan Nos. 15 and 30. The population of Katgaon is 1,750 and Kajuri is 1,200. The Katgaon attack only lasted about six weeks, and stopped altogether.

5884. That was the shortest time?—Yes, that was the shortest time.

5885. We have cases in which a village has been evacuated, and no cases of plague have occurred after the evacuation. I should like to have some definite facts showing that the method you claim to be as near perfect as possible is really better than any other method that has been tried?—I may say that I have no experience at all of any other method.

5886. Perhaps you could add certain particulars, for instance, the population of each village, when the plague began, and when it was stopped. If such details were added to the figures you will give us we can draw our own conclusions?—I will do that.

5887. (*Mr Cumine.*)—You approve of evacuation as a way of stopping plague?—Yes; certainly.

5888. But you object to refugees from an evacuated village?—Yes, going away into other villages.

5889. What would you do then with the people when they were evacuated?—Keep them on their fields as much as possible.

5890. In what way?—Making the patels responsible.

5891. Could a Patel be responsible for 5,000 or 6,000 persons?—I think as a rule patels have a good deal of influence over villagers if they have land. That is not so much the case with shop-keepers: if they choose to bolt, it is very difficult to prevent them. But with landholders in villages I think it is possible to exercise a certain amount of influence and keep them from going away: at least I have found that I have not had anything like the exoduses from any of the Nizam's villages that have taken place in the British villages,—nothing like it.

5892. You have not had a town of 70,000 people affected, have you?—No, certainly not.

5893. With regard to telegrams from adjoining British districts stating that plague had appeared and was advancing nearer your borders, I suppose the Collectors would address those telegrams to the Resident would they not?—I fancy so. Certainly I never received any telegrams until quite recently, the last two or three months.

5894. The authority they would naturally be addressed to is the Resident, is it not?—Yes.

5895. With regard to the eradication of plague, is it a fact that after a certain time plague will die out of itself in the evacuated houses even though nothing is done?—I cannot speak of that because we have had no opportunity of testing it. In the Nizam's State we have evacuated the villages, dug up the floors, and burnt them, so that I have no means of telling whether plague would die out of itself or not. In the villages round Sholapur they have evacuated and taken off the roofs of the houses but they have not disinfected in that district, and I think in the majority of villages there has not been a return of plague.

5896. (*Prof. Wright.*)—Will you give us some particulars as to how this particular sample of plague earth (see question No. 5491) was collected?—I took a small glass tube with me, scraped up a quarter of a tea-spoonful of earth from the surface, put it into the tube and sealed the tube up.

5897. How many plague cases had there been in that house,—I have seen that rabbit inoculated with that particular specimen of earth, and the rabbit died to-day?—These were taken from four houses: I do not know whether any plague deaths occurred in them or not. I took four houses

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* See Appendix No. XVIII in this Volume.

† The figures supplied by the witness are printed in Appendix No. XVIII in this Volume.

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at random in one village. I found all the houses locked up, and the four padlocks which were easiest to break open I broke open and went into the houses.

5898. So that the rabbits died of earth, but it is not known if it came from a plague house ?—I know there was plague in the house. I cannot give you the number of deaths; but there was a circle with a "D" in it, which is the mark we have on houses to show that there have been deaths from plague. On the four houses there was a "D" in a circle. I could get all the information necessary, and let you know in the course of three or four days the exact number of deaths in the house.

5899. This earth was collected from a house where you know deaths have taken place ?—I brought four samples. The other three samples have not been examined.

5900. But this particular one which we are to see, do you remember the particulars as to where it was collected: was the earth plainly contaminated in the portion you took it from ?—It was taken from the place I generally take samples from. I generally ask if there have been any deaths, and where the person has died. If there have not been any deaths, I ask for the sleeping place, and I am shown the place on the ground where the people usually sleep. I take the sample from that place.

5901. This is a sample taken from an ordinary sleeping place ?—Yes.

5902. Was the earth a particularly soiled piece of earth: was it for instance plainly contaminated with fæcal matter, or anything of that kind ?—No. I scratched it off with a raper. It took me three or four minutes to get it. It was only the surface: I did not break the crust of the floor at all.

5903. Was the house a very dirty house ?—No. The places where the people sleep are not dirty as a rule: they are rather clean.

5904. Do you think there would be any chance of finding out whether the case was a pneumonic case of plague ?—I have no opportunities of finding that out.

5905. (*Dr. Ruffer.*)—In your "Memorandum on the method of detecting the plague bacillus in dwelling-houses"* you say, "the likest spots to find infection are the sleeping places or places where plague corpses have been laid out," as you have told Dr. Wright; but then you add, "the undisturbed corners of the rooms"; how, in your opinion, does the plague bacillus get into undisturbed corners of rooms ? —I have not the least idea.

5906. How can it get there ?—I have never found it in earth taken from near fire-places and from doorways and where there was a good deal of traffic; but I have taken earth from the corners of rooms and have found it there. How it got there I do not know. The corners of rooms are used as spitting places.

5907. I believe, also, it does not like dry places: undisturbed corners, I take it, would be the dryest ?—Sleeping places are very dry too.

5908. (*The President.*)—How are the floors cleaned ?—I do not think they are cleaned at all.

5909. Not swept ?—They are swept, but I do not think they are cleaned in any other way.

5910. Are they swept ?—Yes.

5911. If they are swept, would not these corners receive the dust, and the dust remain undisturbed in those corners ?—It is quite possible that in sweeping the surface of the room, the dust may settle in the corners, and the corners, are the least likely to have the dust swept out of them.

5912. (*Dr. Ruffer.*)—You say "undisturbed". If it is swept, it cannot be "undisturbed" ?—I do not know.

5913. (*Mr. Hewett.*)—Does this process of sweeping go on when plague is in the house ?—I do not live with the people and I cannot tell. I fancy everything goes on much the same whether the people have plague or whether they have not.

(Witness withdrew.)

MR. MULLANNAH recalled and further examined.

Mr. Mullannah.

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5914. (*Dr. Ruffer*).—I want to ask you a few details as to the experiments which were given to us by Mr. Stevens upon which I have already examined Dr. Lawrie, but for which I believe you are responsible ?—Yes.

5915. Look at the first page of Mr. Stevens's Report. It is marked "Diary, Hyderabad Medical School Laboratory Condensed by the Plague Commissioner from the daily reports of Mr. Stevens, Deputy Plague Commissioner."* You say here that on June the 16th the inoculated rabbit was found dead. Further on you say, "No micro-cocci were present: the organism was pure plague" ?—Yes.

5916. If you go on to June 19th you will find, "Almost all the cultures from rabbit No. 1 were found to contain micro-cocci." How do you explain this discrepancy ?—That is the opinion written by Mr. Stevens, he is responsible for the notes, not for the experiments. I am responsible for the experiments. The notes were not taken by me.

5917. You disclaim responsibility for this, that no micro-cocci were present ?—I think they were plague bacilli.

5918. Never mind what you think. I asked you whether you accept the responsibility of this statement or not ?—Not of the statement.

5919. (*Prof. Wright*).—Is it an inaccurate account of the experiment ?—I think it is inaccurately put here.

5920. (*Dr. Ruffer*).—Then you are unable to clear that up except by saying that you think it is an inaccurate statement ?—Yes.

5921. In rabbit No. 2, which was supposed to be inoculated with pure culture from No. 1, you say a few micro-cocci were found: how do you explain the presence of micro-cocci in that ? If it was pure plague you should not find micro-cocci ?—Perhaps there was contamination afterwards. If an agar tube was opened several times and examined by several persons, it is possible that it may have got contaminated.

5922. If it has been contaminated, the experiment is valueless ?—It was after the experiment.

5923. Then the experiment is without value if you were not working with pure plague culture ?—We were working with pure plague culture.

5924. How did you find micro-cocci ?—It was examined by different persons. This is the opinion of others. I am not responsible for the opinion myself.

5925. (*Dr. Ruffer*).—I give it up. I cannot find who is responsible for it.

(Witness withdrew.)

MR. MAZHAR HUSSAIN called and examined.

Mr. Mazhar Hussain.

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5926. (*The President.*)—I believe you are prepared to give us some information about plague operations ?—Yes. The principal facts which I have observed and the measures I have carried out in practice during my experience for two years in plague-stricken villages are as follows :—

(1) *Evacuation of Villages.*—The villagers were turned out into the fields outside the village and kept there for a period of two months after the complete disappearance of plague from their midst.

(2) *Disinfection.*—This was effected by means of boiling all clothes and bedding for a full hour.

(3) *Isolation.*—All actual plague cases, contacts and suspects were placed under observation in isolated huts for the requisite period.

(4) *Disposal of Corpses.*—Dead bodies and appendages were burnt in all cases where the religion did not prohibit the same. Those bodies which were not burnt were buried in graves of a minimum depth of 8 feet.

(5) *Destruction of Infected Isolated Huts.*—This was effected by fire on cessation of occupation under all circumstances.

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* See Appendix No. XVIII in this Volume.

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(6) *Isolation of Contacts.*—The period of isolated observation was two weeks.

(7) *Disinfection of Infected Villages*—

(*a*) Thatched roofs were carefully removed and burnt. In the village of Alunga in the case of dark ill-ventilated pucka buildings, holes were made in the roof to allow of the free passage of light and air.

(*b*) All rags, refuse and other insanitary articles were burnt.

(*c*) The floors were whitewashed and dug up to a depth of 6 inches and the earth so removed was burnt by the kiln process originally planned and carried out by Mr. A. H. Stevens, Deputy Plague Commissioner, in plague-affected villages. This process was carried out in all houses of affected villages irrespective of actual infection. After this, the floors were relaid, the walls lime-washed, and the houses considered fit for re-occupation.

After the evacuation of a village the fall in the mortality was very striking. For example in the village of Wagdari (population 300) the mortality before evacuation was 4 deaths per diem. After evacuation it fell to 2 per diem for the next three days, then to 1 per diem for the next four days, and then 1 case every 3 days, finally 1 case a week, and then complete cessation.

Two months after the complete cessation of deaths from plague all the villagers were allowed to re-occupy the villages after duly having their clothes and bedding boiled.

The following symptoms were observed in plague-stricken patients :—

(1) In the beginning there was slight fever, body-pain and lassitude. On the second day the fever increased with severe head-ache and unsteady gait, enlargement of superficial glands in the groins, armpits and neck, tongue typically typhoid, rapidly supervening coma and death. Death generally occurred on the 3rd day, but in some rare instances occurred as long as 7 or 8 days after the onset of the severer symptoms. Acute pneumonia was often the only prominent symptom.

I never saw a single case of plague among infants, although I have seen a mother die of plague leaving a perfectly healthy infant.

Treatment.—I gave the red iodide of mercury in pills of 1-12 grain every 3rd hour with a fair amount of success.

5927. (*Prof. Wright.*)—Does that apply to one village only ?—Many villages : it is the general result of different villages.

5928. (*Mr. Hewett.*)—Did you examine the corpses of the plague patients ?—Yes, I examined many corpses.

5929. Are you in the habit of doing this ?—Yes.

5930. Have the people any objection to it ?—Some of the Muhammadans object on account of the females.

5931. But do you examine the bodies of females ?—The females I did not examine. There are very few Muhammadans in the villages.

5932. (*Mr. Cumine.*)—Was Pallaskhira one of the villages in which you were employed ?—No.

5933. Where were you employed ?—In lots of places.

5934. In which group were you ?—In Pasalgi, and Alunga and Ganjoti,—in the Naldrug district.

5935. How many villages had you under you ?—About 16 villages.

5936. Do you mean that you had sixteen villages under you at any one time ?—No ; three villages.

5937. Was that the most at one time ?—Yes.

5938. In the three villages whom had you to help you ?—There were some other medical officers.

5939. Who saw that the people were buried in graves eight feet deep ?—I saw it.

5940. In the three villages ?—Yes.

5941. Whom had you to help you to see it ?—The military guard, the Patel, and the Patwari.

(Witness withdrew.)

(Adjourned till Thursday, December 22nd, at Wardha.)

At The Sessions House, Wardha.

EIGHTEENTH DAY.

Thursday, 22nd December 1898.

PRESENT :

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

COLONEL G. HUTCHESON, I.M.S., called and examined.

Colonel G. Hutcheson.

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5942. (*The President.*)—You are a Doctor of Medicine ?—Yes, of Glasgow University, and Licentiate of both Colleges of Edinburgh.

5943. You are the Administrative Medical Officer of the Central Provinces ?—Yes, and Sanitary Commissioner. The offices are combined in this Province.

5944. I understand you have had two epidemics of plague in this district ?—Yes. In two towns of the district, small towns you may call them.

5945. And these towns were ?—Hinganghat and Wardha.

5946. What is the normal population of Hinganghat ?—Between 10,000 and 11,000.

5947. On what date were your suspicions of there being plague aroused ?—On the 19th November, by a telegram from the Deputy Commissioner of Wardha. Hinganghat is within the Wardha District.

5948. We will take Hinganghat first. Knowing that the plague was surrounding you, you had previously made some arrangements ?—Yes.

5949. Will you kindly tell us what they were ?—There had been a series of orders issued, to the extent probably of ten different orders, previous to the date of the outbreak, with regard to the precautions against importation both by railway and into villages.

5950. What was the nature of these precautions ?—With regard to the importation by railway there were medical officers at two or three points, divided into major and minor inspecting stations on the railway.

5951. What did these officers do ?—They inspected all arrivals from any infected area at certain stations.

5952. The people who left the trains ?—Yes, those who came by rail were all inspected, and any suspicious case such as a case of fever was removed and segregated.

Colonel G. Hutcheson.

22nd Dec. 1898.

5953. For what length of time ?—Ten days.

5954. Have you any idea how many people you isolated in this manner ?—Several hundreds.

5955. How many cases of plague occurred among those ?—From the commencement of the outbreak in Bombay, probably 20.

5956. They were segregated at certain railway stations in the province ?—Yes.

5957. Were these cases a source of infection ?—Only in one case, a case lately at Khandwa.

5958. How did this case spread the plague ?—It was the case of a man who arrived from Bombay at a certain date in October. He was put under observation at Khandwa for ten days and about seven days after his arrival there he developed symptoms of plague. That was on the 25th of October and he succumbed to the complaint on the 29th.

5959. Were there any further cases ?—The second case occurred in the person of a boy aged 9 who was attacked on the 2nd November. He had been under observation. He lived in the same series of huts as the first case and had never been absent from Khandwa. He lived and slept on the verandah outside the room of the man who died.

5960. Are you aware if there had been any personal contact ?—He was playing in and about the verandah of the hut right in front of the hut of the man who died. The man is known to have vomited on this verandah and probably passed other secretions in and about the place where this boy was.

5961. Were there any other cases ?—There was no other case, but in the same house several dead rats were found after the death of the man. This is rather an important outbreak with regard to the sequence of events. The man died on the 29th, and was supposed to have been taken ill on the 25th or a little earlier—it was known he had plague on the 25th. A rat was found dead on the 30th October in the house which had been occupied by this man, though he had been taken to the Plague Hospital, and on the following day two other dead rats were found. The rats were found in such a state as to preclude the idea that they had been long dead.

5962. Did any fresh cases occur ?—No.

5963. These cases were isolated at once, I suppose ?—Yes they were taken to an isolation hut which had been previously erected for the purpose.

5964. Outside of the confines of the town ?—Yes, and kept under strict observation. Both cases had been under observation. The man from Bombay had been under observation and the boy was immediately segregated on the occurrence of the first case, as he lived near the man who had imported the disease.

5965. Who were the other inmates of this house ?—Two of the man's relatives, a child and an elderly man.

5966. There were therefore four people in this house only, including the boy on the verandah ?—Yes.

5967. What was the history of the other two ?—They were segregated and there was no further developement of the disease.

5968. What steps did you take with regard to the house itself after these cases occurred ?—The house and all its belongings were burnt; fire was applied to anything which could be burnt, to the roof, and all the woodwork The house was unroofed. In addition to that, the floor of the house was taken up and kiln burnt to the depth of 6 inches.

5969. Was the verandah upstairs ?—No, it was on the floor. There was no second floor. The walls were scraped as well and were kiln burnt with the rubbish from the walls.

5970. Was the woodwork of the verandah burnt ?—Yes.

5971. What about the floor of the verandah ?—It was all turned up and burnt in a kiln outside.

5972. Did you use any disinfecting substance ?—Perchloride of mercury was freely used in a solution of 1 in 1,000 previously to the burning.

5973. And the clothes ?—The clothes of the patient were burnt with the body; fire was applied to all materials connected with the patient.

5974. Has this house been reconstructed ?—I am not aware of that, but I fancy it has.

5975. You do not know whether it has been reoccupied ?—I do not know at present.

5976. Now with regard to Hinganghat, when was your attention first directed to any suspicious cases ?—By a telegram from the Deputy Commissioner of the Wardha district, Mr. Chitnavis, to the effect that he required the services of a special Medical Officer to indicate the nature of the fever which was prevailing at Hinganghat.

5977. This was on the 19th of November ?—That is the date. On that date, on hearing of the occurrence, I wired to the Medical Officer of the district asking for information with regard to the nature of the fever which he had reported and called for the services of a special Medical Officer to investigate. Mr. Hogan wired back "two cases enlarged glands not decided," meaning that he had not arrived at a definite conclusion with regard to the nature of the disease.

5978. What steps were taken ?—Dr. Hammond was despatched the same day to report and enquire into the cause of the fever occurring there, and into its nature.

5979. And what did he report ?—The Medical Officer of the District, Mr. Hogan, reported on the advice of Dr. Hammond that plague was existing at Hinganghat.

5980. You got a telegram, I think ?—On the 20th, that plague certainly existed at Hinganghat and there were nine deaths in the last two days and seven sick, certain to die.

5981. Then what did you do on receiving this definite information ?—I immediately proceeded with the Commissioner of the Division to Hinganghat the same evening, and on my arrival there at 10 o'clock that evening we arranged for a close inspection of the town the following morning. I was able to confirm that plague existed in an epidemic form in the town of Hinganghat.

5982. Was it restricted to any locality ?—At that time it was restricted to one mahal.

5983. And what did you do when you got these cases ?—An arrangement was made for the evacuation of the whole mahal, the whole of this portion of the town, and the cases were removed to the segregation camp.

5984. And the other inhabitants of the locality ?—They were removed to an observation camp at the same time.

5985. How long did you take to effect this removal ?—By the evening of that day.

5986. Can you tell me how long roughly ?—About six hours.

5987. The hospital camps and the segregation camps were already there ?—Huts had already been erected; they had simply to remove the cases. There were not many to begin with.

5988. How many people were thus removed ?—Probably about 500.

5989. What was done with the houses ?—A police guard was put in the principal thoroughfares to prevent access to the locality.

5990. And then subsequently ?—Subsequently there was disinfection of the whole of the houses, a saturation with perchloride of mercury of every portion of the house, roof, walls and floors, and the verandahs were disinfected by the same method.

5991. Was there any kiln burning ?—Several of the huts in which plague cases occurred were burnt right out.

5992. Were the floors specially treated in addition to being saturated with disinfectant ?—Not at the time.

5993. At some other time ?—The floors were taken up and kiln-burnt in each case.

5994. That refers to houses occupied by about 500 people ?—Yes, the whole of the floors were not taken up but only those of huts in which cases had occurred.

5995. How many houses do you think were occupied by these 500 people ?—I am probably under-estimating the numbers we turned out; it might be 1,000.

5996. A very large number of houses ?—Probably five individuals to one house as a rule.

5997. Then these 1,000 people were separated into different sections—sick, contacts and neighbours ?—Yes.

5998. And kept separated from each other ?—Quite separate without any inter-communication as far as possible.

5999. How did you prevent inter-communication ?—By a police guard; but I must say the police guard was inefficient. The numbers were not sufficient for the purpose.

6000. In order to prevent their return to those houses which you evacuated, what did you do ?—The area in which the cases occurred was barricaded in different directions, and a police guard surrounded that area to prevent access.

6001. Can you tell us what happened in the camps in the first place in reference to any extension or subsidence of the

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plague?—On the 20th it was reported that there were nineteen cases up to that day. On the following day the cases were not very numerous, three cases and three deaths. On the 22nd there were three cases and seven deaths; on the 23rd 4 cases with three deaths; on the 24th three cases with two deaths; on the 25th, after a house search, six cases with three deaths. After that the cases subsided rapidly.

6002. By what day was the removal effected?—By the 21st.

6003 The people were all in their huts?—Yes, segregated and under observation.

6004. (*Prof. Wright.*)—Do these figures apply to the whole of the town?—Yes.

6005. (*The President.*)—Not the area segregated?—No, they were occurring only in this mahal.

6006. Before you segregated how many cases were there?—Nineteen cases with nine deaths on the 20th and three cases and three deaths on the 21st; after that they diminished rapidly. On the 26th there was no attack and two deaths. On the 27th no attack and one death; on the 28th no attack or death; on the 29th one attack and no death; on the 30th no attack and one death, and on the 1st of December no attack and no death. Then on the 2nd there were six attacks and two deaths, but that I think was due to a specific cause.

6007. There seems to be a recrudescence on December 2nd?—Yes.

6008. What do you think was the reason of that?—It seemed to result from an error of judgment on the part of the Plague Executive Officer. He gave permission to the people who had evacuated the area and gone to the observation camp to enter a mahal to take away grain from the hut which had been infected.

6009. The grain had been left there?—Yes; they had permission to go back to the huts and remove grain and anything else lying about.

6010. Do you think it is probable they might have gone to any other part of the village or town?—Cases were occurring in the adjoining mahal.

6011. That was in a district not segregated?—Yes.

6012. Now you have brought us to the 2nd December?—Yes. The particulars of cases and deaths after that are as follows:—

3rd December	2 cases	No deaths
4th ,,	1 ,,	No ,,
5th ,,	No ,,	1 ,,
6th ,,	5 ,,	1 ,,
7th ,,	2 ,,	2 ,,
8th ,,	2 ,,	3 ,,
9th ,,	3 ,,	1 ,,
10th ,,	3 ,,	2 ,,
11th ,,	2 ,,	No ,,
12th ,,	2 ,,	3 ,,
13th ,,	1 ,,	3 ,,
14th ,,	5 ,,	4 ,,
15th ,,	2 ,,	4 ,,
16th ,,	1 ,,	2 ,,
17th ,,	4 ,,	3 ,,
18th ,,	3 ,,	1 ,,

and so on.

6013. (*Prof. Wright.*)—Are those all the recorded cases?—From plague; they do not include the ordinary mortality.

6014. They include both those which occurred among the the thousand segregated and those which occurred in the town not segregated?—Yes.

6015. (*Dr. Ruffer.*)—You have not a list of the cases occurring in the segregation camp alone?—Yes; very few cases occurred.

6016. (*The President.*)—I should like you to give us the separate figures. I should like to know what occurred after segregation among those thousand people?—That can be given by the local Medical Officer, Mr. Hogan.

6017. Are the cases still occurring?—They are still occurring amongst the persons who vacated this mahal.

6018. How do you account for that?—They were not completely segregated.

6019. (*Prof. Wright.*)—That is, your arrangements for keeping them in the camp were not effective?—That is so. We had not a sufficient police force or guard to take them off directly to the camp from the infected area and see that they remained in the camp.

6020. When a case occurred among the segregated you were not able promptly to remove it to an actual hospital camp?—In the case of the segregated people that was possible, but not among those under observation who had left the town.

6021. You said that a certain number of the thousand segregated people were allowed to return?—A certain number got permission.

6022. And that caused an increase in the number of plague deaths?—Yes.

6023. An increase among the thousand people?—Two cases in the observation camp, not in the segregation camp, occurred directly due to the permission granted.

6024. How long afterwards?—Permission was granted on the 28th and the people went back to the evacuated area on the 29th. On the 2nd there was an access to the number of cases of six; previously there had been very few cases.

6025. (*The President.*)—An access among the thousand?—Yes.

6026. You have given us some particulars about the mortality among rats; has that come under your observation?—No, it is from the reports made by the Tahsildar of Hinganghat. His original report referred to the death of rats.

6027. With regard to the other portion of the town,—you chiefly told us about the segregated area,—I assume that the plague has been increasing in the other part of the town after the segregation?—Undoubtedly, it extended to other portions of the town. People removed from the infected areas instead of being taken direct to the observation and segregation camps,—removed to other parts of the town secretly.

6028. To what extent is evacuation now proceeding in Hinganghat?—Evacuation is the rule. Where cases occur, a large area is evacuated at once. The town is very nearly entirely evacuated now.

6029. Are any other cases occurring in the non-evacuated districts?—There are; there has been a case or two. It is a very important town with grain godowns and lots of valuable stuffs not guarded, and it was permitted in the case of large shops where there were valuable goods to have a chaukidar (policeman) to sleep in the open opposite these large godowns, and in one case the chaukidar was affected.

6030. Why did you not have complete evacuation of the place?—There were only one or two chaukidars left to guard the houses where there was valuable property.

6031. Wherever cases have occurred you have evacuated?—Completely.

6032. Has your experience with regard to the results of this evacuation been favourable or unfavourable?—Most favourable.

6033. Could you state the results?—Cases were occurring, before evacuation, in an epidemic form, and I think if time had been lost and the area had not been evacuated, there would have been certainly a large access of numbers on two or three following days.

6034. There was a marked difference among the evacuated?—Undoubtedly.

6035. Have you figures?—There were really no cases of any kind for some time in the evacuation camp until permission was granted to occupy the evacuated area.

6036. Immediately after evacuating the districts where plague was increasing, plague was stopped among those evacuated?—Yes, undoubtedly.

6037. How long afterwards was permission given to return?—Seven days, from the 21st to the 28th.

6038. In the meantime the houses had been disinfected?—Yes.

6039. And burning to some extent had been carried on?—Yes.

6040. You allowed them to go back in seven days; what was the result?—A considerable access to the number of cases.

6041. Did you have to re-evacuate?—They only had permission to return for one day temporarily; they were not allowed to return to reside there, but only for the purpose of taking their effects and grain away.

6042. Did you find plague occur at once amongst those who had been allowed to go back for a short time?—Yes, in the case of two individuals.

6043. Have you had any occasion to employ inoculation?—It was commenced, but there are no figures to show any definite result.

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6044. When was it commenced?—At different times at Hinganghat—probably about ten days ago.

6045. Has there been any extensive inoculation?—Only a small number and with no definite result.

6046. Have you experienced any difficulty in inducing people to be inoculated?—There is a difficulty; they simply applied for the inoculations to be done in order to obtain a pass which would permit them to go to their various employments.

6047. Those people who wish to go about have chiefly applied?—Yes.

6048. And chiefly to get the special privilege?—Yes.

6049. (*Mr. Hewett.*)—To refer first to the case of the boy, had he come from Bombay?—The boy did not come; he was a resident.

6050. Why did he go to the segregation camp?—He was removed, on the occurrence of the case, to the segregation camp as a suspect, having been on the verandah of the house in which the man died.

6051. Then the man had not been detained on medical examination on arrival?—Yes, on arrival; he developed symptoms on the 23rd of October.

6052. His name and address were taken and he was under observation?—Yes.

6053. You have, in connection with this system of railway inspection, a system of getting the names and addresses?—Undoubtedly.

6054. I understand that you would not say that your experience at Hinganghat furnishes any results which are favourable to the effects of evacuation, because you have not been able to carry evacuation out properly?—No, certainly not.

6055. You say that the recrudescence was due to the fact that people had gained access to the town, is it certain that the fresh attack took place by reason of that?—There were two cases which might be ascribed directly to that cause.

6056. You had a case in camp on the 29th of November, which is within the period of ten days after your original evacuation?—Yes.

6057. The people were under observation in the observation camp?—They were perfectly healthy up to that time.

6058. Were they able to do as they liked or was the guard over them efficient?—It was efficient enough with regard to the evacuated area, because the evacuated area was barricaded and police constables were placed at each corner of the evacuated area. It was a square block and could be easily guarded.

6059. What do you say was insufficient?—The arrangements with regard to the people leaving camp, but not the arrangements in the evacuated area. I think the evacuated area in the first instance was properly guarded.

6060. The town of Hinganghat appears to be generally infected?—Yes.

6061. But you have not cleared out everybody?—Yes, we have.

6062. You have them all under observation?—Yes.

6063. (*Prof. Wright.*)—Have these houses been disinfected before the people were allowed back?—Yes.

6064. Was there grain in large quantities in the houses?—In some cases there were very large quantities.

6065. Was any attempt made to sterilize and disinfect it?—Yes.

6066. How was that done?—It was removed outside the evacuated area and sun-dried and the bags and sacks in which the grain was stored boiled and sterilized previously to being removed.

6067. Was the grain put back?—No, it was taken away by the merchants and disposed of elsewhere.

6068. I thought you said the people were allowed to go back to their houses to get the grain?—Yes, permission was wrongly given.

6069. When the people were first evacuated was the grain taken outside?—No, it was afterwards. They were not supposed to approach the houses. They were inadvertently given permission prior to the grain being sterilized.

6070. They were allowed in to take the grain out before it was sterilized?—Yes.

6071. How was disinfection done in a house in which there were large stores of grain?—They were specially instructed to avoid this infected grain. The disinfection was done with the ordinary perchloride of mercury solution. It was intended to sterilize the grain before its being removed, but in the meantime permission had been wrongly given to the people to return and take the grain away without being sterilized. It is a big market and a very large stock of grain was there in that particular mahal, and it certainly would take ten days or a fortnight, or more, to sterilize the grain.

6072. There was no thorough disinfection of the houses if the grain had not been taken out?—Yes, undoubtedly. In ordinary huts the stock of grain was very limited.

6073. Then they were allowed back to a house which had not been satisfactorily disinfected?—They were saturated with the perchloride of mercury solution.

6074. But the places where the grain was stored, which are fairly large areas in the house, could not have been touched at all?—No, but these were godowns and not the usual habitated huts.

6075. There was a disinfected part in each house?—Not in each house.

6076. In many houses?—Yes.

6077. What I mean is it is no argument against allowing people to return to disinfected houses because large portions of those houses were not disinfected?—A very small portion might remain not disinfected. Only the large merchants' houses facing the main street, containing large quantities of grain, containing areas in which grain was stacked probably to the extent of 200 or 300 bags, could not be disinfected thoroughly.

6078. And those are the most dangerous portions of the house if rats are to carry infection?—Undoubtedly, and it was not intended that they should go back until after the grain had been disinfected.

6079. (*Dr. Ruffer.*)—When these people went back from the evacuation camp to the town was there still a good deal of plague in other parts of the town?—No, probably one or two cases.

6080. Might these people have infected themselves from these cases?—It is very unlikely, but it is possible. The number of cases which were occurring at that time were few or none. There were no deaths and no attacks for some days. From the 26th to the 1st there was only one attack and there were four deaths, probably in hospital.

6081. (*The President.*)—Was that in the area segregated: or does it refer to the whole town?—That refers to the whole town and the whole class of cases occurring in that period, including the segregated.

6082. (*Dr. Ruffer.*)—Is the plague still going on in the evacuation camp now?—There were one or two cases subsequently in the observation camp.

6083. You say in your précis of evidence that "Hospital Assistant Mohan Lal, in charge of the local dispensary, admits having seen and healed on the 11th November a patient suffering from fever with glandular swellings and makes a statement that he observed cases of the same nature fifteen days before that date. No report of these early occurrences was made." I suppose you heard of these afterwards?—Yes.

6084. You do not know why he did not report those cases?—No.

6085. As a matter of fact plague may have been in the place for months before that?—Probably it may have been there for days previously.

6086. He says he observed cases fifteen days before that date; that takes us to the 25th October?—Yes.

6087. And you say further that a certain man was ill with plague on the 6th November?—Yes.

6088. And he did not report these cases?—He did not. There was no report made till the 20th, no direct report.

6089. (*Prof. Wright.*)—What means have you for compelling a report to be made now?—There is no notification in India, you cannot compel anyone to make a report except in the Municipalities.

6090. If a case came under the observation of an Assistant Surgeon, would he not be bound to report it to you?—Yes.

6091. Is that the case here?—He did not report.

6092. (*Mr. Hewett.*)—It came under the observation of the Hospital Assistant whose duty it was to report, and he neglected his duty?—Undoubtedly he neglected his duty.

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6093. It was a doubtful case and he should have reported it to the Medical Officer of the district at once?—Yes.

6094. (*Prof. Wright.*)—That is of frequent occurrence, is it not? What measures have you for enforcing these reports?—It is only when we ascertain that cases have not been reported that we can take measures to censure the individual and remove him.

6095. (*Mr. Hewett.*)—You have to rely upon an unreliable agency?—Yes; in India, for all these cases. You have no expert agency as you have in England.

6096. (*Dr. Ruffer.*)—May I point out something else in your précis of evidence? You put in the statement of the daily mortality in Hinganghat up to the 21st November?—Yes. The following statement indicates the mortality at Hinganghat from 1st to 21st, inclusive, and shows the actual number of deaths in the Jagannath Muhalla especially affected with plague.

Daily mortality in Hinganghat.

November 1st to 21st, inclusive, according to Statement in Police Book.

Date.	Cholera.	Fever.	Bowel complaints.	Chest complaints.	Plague.	Other causes.	Total.	Deaths in Jagannath Muhalla.
1st . .	...	1	...	...	...	...	1	1
2nd . .	...	...	...	...	...	...	...	...
3rd . .	...	...	...	...	...	...	...	...
4th . .	...	...	...	...	1	1	1	...
5th . .	...	1	...	...	...	...	1	...
6th . .	...	1	...	...	...	...	1	1
7th . .	...	3	...	...	...	...	3	3
8th . .	...	...	...	...	...	...	...	...
9th . .	...	1	...	...	...	...	1	...
10th . .	...	3	...	...	...	...	3	2
11th . .	...	1	...	...	...	...	1	1
12th . .	...	1	...	...	...	...	1	...
13th . .	...	1	...	...	?	...	1	1
14th . .	...	3	...	...	?	2	5	...
15th . .	...	3	...	1	?	1	5	3
16th . .	...	3	...	...	...	...	3	1
17th . .	...	7	...	...	?	...	7	5
18th . .	...	3	...	...	?	1	4	2
19th . .	...	2	...	...	?	...	2	2
20th . .	...	7	...	...	...	1	8	4
21st . .	...	5	...	...	...	2	7	5
TOTAL .	Cholera. ...	Fever and Plague. 46		1	1	8	55	31

Fever and Plague	46			
Chest complaints	1			
Other causes	8	Total .	55	Deaths in Jagannath Muhalla.
Total .	55			

6097. You put in the same column fever and plague, total deaths 46, and then you have a fresh column of plague in which you have one case. I suppose you mean that among these fever cases there may have been cases of plague?—That is so.

6098. (*Mr. Hewett.*)—The mortality in Hinganghat, in the period shortly before plague was detected, was materially less than in previous years, was it not?—Undoubtedly.

6099. So that there was nothing to draw your attention at the head office to the existence of plague unless your subordinates on the spot reported properly?—That is so.

6100. Will you kindly in a similar manner give your opinion with regard to Wardha?—We have no notes about Wardha at all.

6101. What is the population of Wardha in the first place?—Between 8,000 and 9,000.

6102. What is the occupation of the inhabitants, generally speaking?—They are generally engaged in field occupation and in the cotton industry.

6103. Are they engaged in the cotton industry to as great an extent as the people of Hinganghat?—About the same.

6104. The predominating industry is agricultural?—Yes.

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6105. When was your attention directed to the occurrence of plague in Wardha?—On the 7th December.

6106. What was the information then before you?—The Civil Medical Officer wired that there had been two deaths within the previous 24 hours and two cases at Wardha on the 6th of December.

6107. Who is the Civil Medical Officer?—Mr. Hogan.

6108. What measures did you thereupon adopt?—The houses were immediately evacuated in the vicinity of the occurrence of those cases. A block of houses within the area of inspection was immediately evacuated and all the inmates taken to the segregation camp and there isolated for the time being.

6109. And the patients?—The patients both died.

6110. Did you adopt any means to prevent the inhabitants of an uninfected block from communicating with the infected block?—Yes, the same means were adopted.

6111. You had a barricade?—Yes, and a police guard.

6112. Was this effective?—About the same I fancy; the guard was small.

6113. How many people did you evacuate in Wardha?—About 150.

6114. Not so many as in the previous case?—No.

6115. You took a smaller area?—Yes.

6116. Did plague occur among these 150 people after evacuation?—I do not think any case occurred among the evacuated. Mr. Hogan can give you the date of those cases, but so far as I know there was no other case amongst those people except one woman, the wife of one of the patients who died on the 6th, who took plague fifteen days afterwards.

6117. Did she die?—She still lives.

6118. Were there any other cases amongst those evacuated?—Not to my knowledge.

6119. Has plague occurred in any other part of the town?—Yes, it has been spreading in the different mahals in the town.

6120. What proportion of the town has been evacuated?—We have evacuated very largely, nearly the whole of the town.

6121. The population is nearly all in camps?—Yes. There are a great many of them in the observation camp, but when the town was being evacuated the people got a hint that it was time they should leave certain mahals prior to the occurrence, and they were allowed to form private camps.

6122. Under what conditions are they permitted to return to Wardha?—They are allowed no privileges with regard to the evacuated areas. They are allowed fairs and markets outside the evacuated area.

6123. Have they got some mills and places where they follow their occupations? Do they return to those?—Yes, they are permitted to return there.

6124. How have the evacuated houses been treated?—They are first disinfected with perchloride of mercury, the usual solution of 1 in 1,000; the saturation is made complete. In some cases the house has been burnt down completely.

6125. How do you think that the first case in Wardha occurred?—I fancy there were cases which were kept secret: there has been concealment.

6126. You think that the people themselves concealed them?—Yes.

6127. Did the cases come under the observation of any of your officials?—The officials had been told. A certain committee had been formed to make a house to house visitation, and the enquiry from the beginning of the epidemic in Hinganghat was supposed to be carried out efficiently; but my experience of house to house enquiry shows that it is quite ineffective and cannot be relied upon.

6128. Was it amateur organization or were they paid?—They were officials for the most part. But it is a cursory examination; they merely make enquiry and there may be a case in the house; concealment is very common.

6129. You have not attempted to make a census?—No. The only thing which would be effective is a house to house search in these cases.

6130. Would that be possible?—You would require to use force in some cases.

6131. What are the castes you deal with here?—The most important caste is the Mahratta Brahman. He resents interference very much. Force would probably lead to a riot in a big town.

6132. They do not like their houses to be inspected?—It is only fear or dread of any occurrence in their own surroundings that leads them to evacuate an area.

6133. Your subordinates did all they could to obtain information?—Yes, but they were helpless in the matter. When there is a case in a house the people might even put a padlock on the door and pretend it is a closed godown. There is a pretence of information, but there is no information obtained.

6134. Can we get information as to how far plague occurred among the people in the town before they evacuated it, and how far it has occurred among the people in the different camps since the evacuation?—Undoubtedly.

6135. Who will give us that?—Mr. Hogan.

6136. Both Wardha and Hinganghat are Municipalities I think?—Yes.

6137. There they have special means for registration of deaths?—Yes.

6138. What is the means by which you get registration of deaths in the rural areas in the Central Provinces?—By the kotwals or chaukidars of the different villages.

6139. To whom do they have to report?—To the police station—to the nearest registration unit.

6140. Do the reports go both to the District Officer and to the Civil Medical Officer?—Yes.

6141. And they eventually come under your notice?—Yes.

6142. Supposing that there was an abnormal number of deaths in a particular village, whose duty would it be to call attention to that? Who is responsible for taking action, supposing the returns sent in by the kotwal or the police show an abnormal mortality in a village?—The Civil Medical Officer in charge of the district is supposed to make enquiries with regard to any abnormal death rate in any particular area within the district.

6143. Has there been any abnormal mortality among the villages in the Wardha district?—No.

6144. There is nothing to indicate that there is plague about outside those two Municipalities?—Lately there has been a report from one village that deaths were probably reported irregularly. One week there were a few deaths reported, but it was supposed the chaukidar did not report them all in one week, but reported some in the next week.

6145. You have found that there is not an abnormal mortality in that case?—Yes.

6146. You are satisfied that among the rural population there is no abnormal mortality?—Yes. There is a case under investigation of a town with regard to the mortality there now.

6147. Is the mortality abnormal there now?—A little abnormal. It is accounted for probably by other reasons. There is generally a high mortality at this time of the year.

6148. It is not likely there is plague anywhere else?—No.

6149. Because you have your eye upon it?—Yes, and the rules are very strict that any case of abnormal fever should be at once reported.

6150. You were Sanitary Commissioner in the North-Western Provinces before you came here?—Yes, for seven years.

6151. And Kumaun and Garhwal were under your jurisdiction?—Yes.

6152. Mahamari frequently occurred there?—Yes, periodically in epidemic form.

6153. It came under your personal observation while you were Sanitary Commissioner?—Yes.

6154. How often?—Three times.

6155. You have also done your best to investigate the history of the disease by referring to old reports?—Yes.

6156. According to your experience and that of the authorities referred to, does that disease appear in the valleys or on the tops of the Hills?—In every portion of the inhabited area.

6157. Of the outer range?—Not in the outer range usually, but it has occurred in the outer range and on the plains.

6158. The inhabitants are almost all Hindus I think?—Yes, the Muhammadan population is limited.

6159. And they are dirty?—Undoubtedly.

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6160. They rarely wash?—Like all Hill-people they wash very rarely.

6161. What is the system of arrangement with regard to cattle, as a rule, there?—The houses there are built in two storeys and the cattle used to be housed under the living quarters.

6162. The people are in the upper storey and the cattle below?—Yes.

6163. Can you describe the state of one of those houses during rain?—It was simply a mass of all kinds of filth, animal and vegetable decaying matter.

6164. Have attempts been made to change the practice of keeping cattle underneath the houses?—Yes, and to get them to keep the cattle at a distance from the dwellings.

6165. Did those attempts fail?—They failed in a measure, but the improvement was adopted in some cases.

6166. Does this disease occur in the hot weather or in the rains?—At both periods—at all periods of the year, in the hot weather, in the rains, and when snow is lying thick on the ground.

6167. Do the characteristics of mahamari differ from or agree with those of plague?—They absolutely agree.

6168. Do you know whether there has been any bacteriological examination of the blood of a patient suffering from mahamari?—There is a medical examination of patients and we have the results of *post mortem* examinations.

6169. The *post mortems* have not extended to an examination of the blood?—No.

6170. Have you any experience of the connection of rats with mahamari?—It is evident that the disease may primarily affect rats or they may be secondarily affected, and that a man may communicate the infection to rats or *vice versâ*.

6171. Have instances come to your knowledge in which rats have been primarily affected, or are you merely speaking of the reports of the people?—I have no personal knowledge that infection was conveyed primarily from rats.

6172. The villagers do say so?—Undoubtedly. There have been cases of a large mortality among rats followed by an outbreak of mahamari and also cases where people have evacuated a house at once because of the mortality among the rats and there was no outbreak.

6173. What do the people do when they get mahamari?—They immediately evacuate the whole area of the village; they are more sensible, in one sense, with regard to danger arising from mahamari, and as a rule without pressure

Hardwar last year came from the Hills?—No, I think there is a more reasonable explanation.

6185. Your experience of the fairs at Hardwar does not lead you to believe that it would come in that way?—No, the Hill people do not independently mix with people at Hardwar; they usually occupy the opposite bank of the Ganges.

6186. Do you think that plague was conveyed into Bombay by pilgrims from Garhwal without any cases having been detected between Bombay and Garhwal?—It is very unlikely but it is possible.

6187. (*Prof. Wright.*)—Are there long periods up there in which you find no case of plague?—It is not under sufficient supervision for us to know, but I think the people of that area are quite alive to the occurrence of plague, and leave their houses at once and it thus becomes known to the authorities. I do not think many more cases occur than are reported.

6188. Do you know if there is any mild form of plague which is characterised by buboes occurring apart from any high fever?—I do not think so; I do not think there is any mild form. It occurs in such a marked form that it is at once recognisable.

6189. Have you been up yourself in Kumaun, and have you seen cases?—Yes, but have not seen cases.

6190. Have you ever seen a pneumonic case in Kumaun?—No. I have not.

6191. Is evacuation the only method which is adopted?—The houses are burnt outright, everything that can be burnt.

6192. Do the natives do that?—No. Orders have been issued of late years.

6193. (*The President*).—Is it a very fatal disease?—Extremely fatal. The last account of it I recorded was that there were only two houses affected and each member of the family died; in one house six and in another house five.

6194. (*Mr. Cumine.*)—How long do they remain out?—For a very long period; from six weeks to two months or more.

6195. And then when they come back the houses are safe?—The houses are supposed to be safe after a prolonged period. They always consider if they come back too early plague is likely to light up again.

6196. (*The President.*)—Is there an European Doctor there?—Yes.

6197. Would it be possible to have a microscopical or bacteriological examination?—Cases are probably not occurring

3. The total mortality from all causes, week by week, in the town during the period of plague.

Plague was announced on 20th November. The mortality is as follows :—

November	3rd week	39
„	4th „	21
December	1st „	10
„	2nd „	31
„	3rd „	13

4. The total mortality from plague alone, week by week, in the town, during the period of plague—

November	1st week	*Nil.*
„	2nd „	*Nil.*
„	3rd „	19
„	4th „	12
December	1st „	8
„	2nd „	16
„	3rd „ (up to 20th)	11

5. The total number of contacts segregated, and the average period of their detention—

Total number	252
Average period of detention	15 days.

6. The average population of contact camps, week by week. Camp opened on 21st November 1898 with 12 admissions—

Average population during week ending	28-11-98	113
„ „	5-12-98	147
„ „	12-12-98	117
„ „	19-12-98	145

7. The total mortality from all causes in contact camp,—seven.

8. The total mortality from plague, week by week, in contact camp—

November	4th week	2
December	1st „	*Nil.*
„	2nd „	4
„	3rd „	*Nil.*
	Total	6

Wardha.

1. The total population of the town immediately before the outbreak of plague : approximately 10,000.

2. The average death-rate from all causes of the town in years when there has been no plague—

Average of 1895 and 1896	47·85	per mille per annum.
„ 1897	80·09	Do.

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Note.—This was a famine year and the deaths include those among town people proper, in poor houses, and among wanderers from outside.

Average of 1898. For the first eight months of the year : 2·11 per mille per mensem.

For the remaining period.

Months.	Weeks.				Total.	Remarks.
	First.	Second.	Third.	Fourth.		
September	...	4	1	5	10	
October	4	7	2	9	22	
November	3	6	10	6	25	
December	7	8	12	...	...	

3. The total mortality from all causes, week by week, in the town, during the period of plague.

Plague was announced at Wardha on the 6th of December.

The mortality during first week was seven, second week eight, and third week eleven.

4. The total mortality from plague alone, week by week, in town, during the period of plague—

1st week	2
2nd „	5
3rd „	11

5. The total number of contacts segregated, and the average period of their detention.—87 ; none discharged yet.

6. The average population of contact camps, week by week, as long as they were maintained—

For week ending 15th December	43
„ after 15th to date	80

7. The total weekly mortality from all causes in contact camps : one.

8. The total mortality from plague, week by week, in contact camps : one (third week).

(Witness withdrew.)

MR. HOGAN called and examined.

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6198. (*The President.*)—You are Civil Medical Officer of the Wardha District?—Yes.

6199. What are your medical qualifications?—Military Assistant Surgeon educated and passed out of Calcutta Medical College.

6200. (*Dr. Ruffer.*)—You have sent in a statement; do you put that in as your evidence?—Yes. It is as follows :—

" Hinganghat, 21st November 1898.

" From—The Civil Medical Officer, Wardha District.

To—The Administrative Medical Officer, Central Provinces.

" I have the honor to forward the following report on the outbreak of plague at Hinganghat.

" On the 10th November 1898, I received a report from the Hospital Assistant in charge of the Branch Dispensary, Hinganghat, stating that on inspecting the sanitation of the town he was informed that some dead rats were found in two or three houses in the Jagganath Muhallah, that the sanitation surrounding the above houses was not satisfactory, and that the Tahsildar was having the sanitary defects remedied and had forwarded two dead rats to the Deputy Commissioner in Camp. I sent in Hospital Assistant Chajjumal in charge of the Main Dispensary, Wardha, to Hinganghat by the 10 p. m. train on the 10th November 1898, the first available train. Chajjumal, on arrival at Hinganghat, started a house-to-house inquiry, assisted by the Naib Tahsildar, Sub-Inspector of Police, and the Hospital Assistant of Hinganghat.

" In Jagganath Muhallah three rats were reported to have died in Govind Rao, Judicial Moharir's, house on the 7th : cause not traceable. No disease of any kind, it is said, followed the death of the rats. On the 7th, one rat is said to have been found dead in a vessel of water in the house of Raghoba, an employé in the Hinganghat mills ; two rats, it is reported, were found again in this man's house. On the 10th, no one reported sick in this house. Two rats were found dead in Amirkhan's house on the 7th. No disease was reported to have followed. A girl, said to have been suffering from remittent fever for a fortnight, died on the 9th of November 1898. Up to the 10th, no special disease is reported to have occurred in Hinganghat by the Hospital Assistant in charge, nor was the death-rate of the town abnormal up to the 10th.

" Hospital Assistant Chajjumal returned to Wardha on the 11th, and I started for Hinganghat on the morning of the 12th, and enquired at the houses of three men, where rats are supposed to have died. One man said a cat had killed two rats and his servant threw them on the road. One man said he thought about ten days ago he found two rats dead in his place. One said he was having his place cleaned for Diwali and found two dead rats under some wood.

" Two men came from Bombay on the 4th of the month, and are working in the mills ; both were in good health and were last seen by the Police on 10th November 1898.

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" The following are statistics of deaths in Hinganghat :—

	Fever.	Bowel complaints.	Other causes.	Grand Total.
Deaths in September 1898	15	3	13	31
Do. do. October 1898	12	2	11	25
From November 1st to 7th 1898	6	0	1	7
Do. do. 8th to 11th 1898	4	0	0	4
As against deaths in September 1897	13	36	20	69
October 1897	29	12	24	65
November 1897	17	13	20	50

" Deaths in Jagganath Muhallah from 1st to 11th November 1898, were as follows :—

(1) Janki, wife of Budu carpenter, died on 2nd November 1898, had fever for 8 days.

(2) Indrani, sister of Janki, had fever for 16 days, gradually got worse and died on 5th November 1898.

(3) Krishna, daughter of Harban, shop-keeper, had been suffering from fever for 8 days, took only " dal water " for nourishment—died on 10th November 1898.

(4) Sundri, wife of Chitmal, died after abortion on 10th November 1898.

(5) Mukee, wife of Sheoban, died from fever on 10th November 1898 after 6 days' fever.

" All these people are residents of Hinganghat.

" On the 17th November, I returned to Hinganghat from Pohona, after inspecting the Ginning Factory and Press there, met the Deputy Commissioner and made the following inquiries :—

Deaths from 1st to 16th.	Jagganath Muhallah Deaths 14		Tahsil Muhallah 2
	Morali Muhallah 1	Abkari Muhallah 5	Dangri Muhallah 4
	Sunter Mahullah 2		Rammandir Muhallah 3
		Total 31.	
	17th 3 2	Total 5.	

" Houses visited :—

No. 1—2 deaths, 1 girl, 16 days' fever.
1 mother, 6 days' fever : on constant attendance on the girl.
No. 2—2 deaths, 1 boy, fever 10 or 12 days.
1 father—fever 4 days—78 years of age.
No. 3—1 death, female, 3 days after abortion, uncertain if abortion was caused by fever.
No. 6—1 death,—child—3 days after fever ?
No. 7—1 death, do. 2 days' fever ?
No. 8—1 death, male—adult. 10 days' fever.
No. 9—1 death, do. 21 days' fever.
No. 10—2 deaths, 1 do. 2 months' fever.
1 do. 10 days' fever.
No. 11—1 death, 1 infant 2 days' old, 1 day's fever.
No. 12—2 deaths, 1 female, 6 days' fever. One female adult, 8 days' fever.

—
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" All the above were residents of Hinganghat, had no treatment—some no nourishment absolutely—others only " dal water," mostly living in closed and badly ventilated rooms. In two houses I had to light lamps before I could see the patients. Mohanlal had seen some of these cases. He had no reason to suspect any special disease, of the other cases seen by him, who had swelling in the front of the thigh—not one died ; this is also the opinion of the Hospital Assistant of the mills.

" On the 19th, the Deputy Commissioner and myself enquired into the deaths recorded by Hospital Assistant Mohanlal for the 18th. They were as follows :—

1 Vithu, male, 85 years of age, 8 days' fever.
1 Backaram, 22 do. 10 days' fever.
1 Ganpat, 33 do. 12 do.
2 In Jairam's house.
1 Wife, 60 years of age, 6 days' fever.
1 Gajee, 15 do. 4 do.
1 Radha Krishna, 7 days' fever, muscles and integuments in front of thigh inflamed.
1 Wife of hospital cook—30 years of age—13 days' fever.

" We also saw the following sick shown to us :—

In one compound.
1 Rakhama, female, 20 years old, suffering from fever for 7 days—temperature 99·4°.
1 Bagoo, female, 70 years—fever 15 days—dying.
1 Kashimatu, male, 20 years, fever 1 day, temperature 103·4°.
1 Ratani, female, 40 years, 6 days' fever, had not taken any food since her boy died, 6 days ago, husband died on 16th—temperature 96·8°, dying.
1 Balmukand, male, 50 years, 7 days' fever, temperature 98·6°, seedy looking.
1 Basta, female, 20 years—6 days' fever—temperature 104·9°, inflamed glands, right inguinal region.
1 Nagana—30 years—male—3 days' fever—muscles and integuments and some glands in front of left thigh inflamed.
1 Tajamali, female, 60 years, 4 days' fever.
1 Rangamah, female, 16 years, one day's fever.
1 Jhiblee do. 22 years, 3 days' fever—malarial ?

" Four deaths reported for 18th this morning.

" On return, the Deputy Commissioner and myself wired to the Administrative Medical Officer for Doctor Hammond and microscope for recognizing plague bacillus. Dr. Hammond, who came in last night and helped in the enquiry this morning, has kindly promised to complete these notes with his observations."

6201. You give us in your evidence various dates on which dead rats were found ; have you any evidence to show that these rats died of plague ?—None.

6202. In Hinganghat before the plague broke out, I think the mortality was not as great as in previous years ?—No, it was not.

6203. You give here in your statement a certain number of people whom you saw on the 17th of November ?—Yes.

6204. You saw, I think, twelve houses. Did you think any cases you saw in them were plague ?—No ; there was one case in Hinganghat which I saw on the 17th ; the man told me he had been lifting bales of cloth and had strained himself and got a swelling followed by two days' fever, but on the 17th he was feeling very much better and thought he would be up in a few days. On the 18th that man died, and I remarked at once to Deputy Commissioner that that was a very suspicious case, and we had better go back at once.

6205. Do people often complain of having strained themselves when they first notice the bubo ?—No, this is the first case that I know of.

6206. On the 19th you enquired yourself about the deaths which had taken place and you give in your statement a list of these deaths ; did you think any of these were plague ?—No, because the history of glandular swellings, sudden prostration and delirium was contradicted ; they flatly denied any of those symptoms.

6207. You have here a case of Radha Krishna ?—That is the one I have just mentioned.

6208. Further you have " Ratani, female, 40 years, six days fever, had not taken any food," etc., ; do not you think that was very suspicious of plague, three people having died ?—I examined her and she had no enlargement of the glands. There was a report here which states that they refused all food, and that she died from starvation and shock.

6209. You have no evidence of these cases being pneumonia or septicæmia ?—No.

6210. Still it was very suspicious, three people dying in the same house ?—Yes. On the 19th I saw two suspicious cases and therefore telegraphed for an expert to be sent in.

6211. Further on you have the case of a female 20 years old, named Basta, with inflamed glands in the right inguinal region ; I suppose you recognise that as a case of plague ?—I had my suspicions. I wanted the diagnosis to be confirmed. This is one of the above two cases.

6212. When was the first case of plague in Wardha ?—On the 5th of December 1898.

6213. Did you see the case yourself ?—Yes.

6214. (*Prof. Wright.*)—There were two cases on that day, were not there ?—Yes.

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6215. (*Dr. Ruffer.*)—When was that case reported and sent to the authorities?—I got a telegram that there was a suspicious case at Wardha, when I was at Hinganghat, asking me if I would go and see it. I started at once by trolley and got here on the 6th and saw the case.

6216. When did you report it?—I telegraphed on the 6th at once to the Administrative Medical Officer, the Commissioner and the Chief Commissioner.

6217. How many cases have you had since in Wardha?—Twenty-three attacks of whom eighteen died.

6218. Have you evacuated the town?—Nearly the whole of it.

6219. When did you begin to evacuate the town?—From the 6th December 1898.

6220. How many deaths have you had since among the evacuated people?—Nine.

6221. How many people did you send out of their houses?—1,478.

6222. How many cases did you have among people who have not been evacuated?—10, excluding one case that occurred in the Civil Station; including the case in the Civil Station we have had eleven.

6223. You turned out 300 people on the 8th?—Yes.

6224. When did you turn out the others?—Subsequently from time to time as cases occurred. Some were ordered out and others went out themselves. There was a lot of very intelligent officials, and they went out themselves and the others all followed.

6225. Then they are scattered in the district?—Yes, excepting the contacts and the neighbours who were sent to the segregation and observation camps, respectively.

6226. How do you know of the deaths occurring of people outside the camp? Are they visited every day? I suppose they are not in the same camp but scattered about?—They are in little camps of three or four huts and they are seen by the Superintendents as far as possible. The Superintendents report deaths.

6227. How often does the Superintendent go round to see them?—Every morning, and Supervisors morning and evening.

6228. Does he know the number of people in each camp?—Not in these little camps. We know the exact numbers in our health observation camp and the segregation camp.

6229. But there are a number of camps in which you do not know them?—Yes.

6230. It is conceivable that people might die in those camps and you might not know of it?—Quite possible.

6231. Do you think it is likely?—Yes, but usually when a man gets sick or dies in one of those little camps they take him to a field and somebody brings the message and then the Hospital Assistant or some one else goes to find out what the death was from.

6232. But it is conceivable that a man might die without your knowing anything about it, the body being burnt or buried?—Yes, but no such instance has occurred.

6233. Do you think that is likely?—Yes, it is.

6234. Are the houses disinfected in Wardha?—Yes, under the Plague Executive Officer's supervision and that of the Superintendent.

6235. You do not do it yourself?—No.

6236. Are the people in the camps allowed to go into the village?—No. There is a cordon round and as much is done as a police cordon could do when they are not touching one another. People might dodge in the dark, they may get in in the dark.

6237. Do you think it is probable they do?—Yes.

6238. Who takes care of their houses while they are away?—The Police.

6239. You think it is likely that they get back to their house?—It is possible.

6240. (*Mr. Hewett.*)—Did you examine two mill-hands who came from Bombay?—Not until they were produced before me. They were supposed to be under observation by the Police.

6241. Did you see them?—Yes, I saw them on some date between the 28th November and the 3rd of December.

6242. When did they come from Bombay?—They are supposed to have come in on the 4th of November.

6243. When you saw them were they suffering in any way?—No.

6244. Were there no signs of any buboes?—No.

6245. You do not think that they brought the infection here?—No.

6246. Were they the only people who came from Bombay about that time?—Yes, at that time, the 4th of November. In the letter which I sent to the Administrative Medical Officer I said two men had come from Bombay and arrived at Hinganghat on the 4th November.

6247. Were there no other arrivals from Bombay about that time?—Yes, there are some more arrivals, people with broken tickets.

6248. You say that you had to light a lamp in the houses before you could see the patients?—Yes.

6249. Is there any ventilation or air in those houses?—They are almost air-tight houses. There is a disease they call madura, I do not know whether it is typhus or typhoid, in which case they put blankets over the door and close the hatches, and the only aperture in the room is screened across.

6250. In ordinary circumstances there is not much light or ventilation, is there?—No.

6251. (*Dr. Ruffer.*)—With regard to these mill-hands, I suppose they change the workmen in the mills pretty frequently?—Yes.

6252. I suppose workmen go and come from Bombay pretty often?—I think not, because they have to be careful not to engage anyone from an infected area.

6253. Do you think these instructions are followed?—Not strictly.

6254. (*Prof. Wright.*)—With regard to the number of deaths which occurred daily, do you know how many occurred inside the town and how many outside?—No, not without referring to my documents.

6255. Do you think the figures are available?—Yes, you can get every item, whether it occurred in a field or in a particular hut or in a particular muhalla. We have the whole of that information.

6256. (*The President.*)—Can you prepare that statement?—Yes. (See statements supplied and printed at the end of the witness' evidence.)

6257. (*Mr. Cumine.*)—Would such figures be useful or likely to be misleading?—Certainly useful, they are honest figures.

6258. What I mean is this. People residing in the town often go out into the fields to live, and three days afterwards they may develope plague; would your figures show them as having got plague in the fields under those circumstances?—They are shown as having got plague in fields, and their connection with the muhalla they come from is also shown.

6259. (*The President.*)—Did you see this girl who was said to be suffering from virulent fever and who died on the 9th of November?—No. She was seen by Hospital Assistant, Mohan Lal.

6260. You have already told us that you do not think the sanitary conditions of the houses are good?—No, they are not good, but are the same as you generally find in Indian towns.

6261. What is the system of conservancy? Is there any?—They have a few conservancy carts, and a few rubbish carts, and a certain number of sweepers, but the sanitary arrangements are not what they should be.

6262. What is the nature of the privies?—The public ones are outside the town itself. Some of them are made of corrugated sheeting and the others of brick-work. In the private places there is a little closet in their yard, badly ventilated, and I suppose badly attended to.

6263. Have you seen them frequently?—Yes.

6264. (*Mr. Hewett.*)—What proportion of the houses here have private privies? People are supposed to go to the public latrines, are they not?—Yes, unless they are fairly well-to-do.

6265. What proportion of the houses have private privies?—There are a good number in this town.

6266. (*The President.*)—What is the water-supply in Hinganghat?—Filtered tap water.

6267. When was it introduced?—It was here when I came.

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2668. What is the supply now?—The same; filtered tap water.

6269. Who attends to the sanitary condition?—The Civil Medical Officer, the Hospital Assistant and the Municipal Secretary.

6270. Does it come within your functions?—Yes.

6271. What do you do now when you go to a place and find it insanitary?—I direct the Municipal Secretary to attend to it at once.

6272. With regard to cases where you say there is no window, or other means of ventilation, what steps do you take?—We tell them to make wickets.

6273. When have you told them to make wickets?—Every time I have noticed they have not a window where they should have it, or where there is no free ventilation.

6274. I thought you said practically all the houses are without ventilation?—Not all the houses.

6275. But a very large proportion?—Yes, a large proportion.

6276. Have you reported any of these?—Not more than the usual quarterly reports which I send in. If I go to a house and see it is not properly ventilated, I make a note of it and write to the Secretary about it.

6277. But the remedy apparently has not been applied in a large number of cases?—So far as the means of the people permit they do go on with it; they show their willingness but means are very backward.

6278. Is the overcrowding very great in these houses?—Yes, not in the well-to-do houses, but in the others; there is the usual overcrowding in towns and villages in India; I do not think there is anything here more than that.

6279. When you find a house not properly ventilated and lighted, you write to the Municipal Secretary?—Yes, when I notice it.

6280. (*Mr. Cumine.*)—What legal power has the Municipality to put in a window in a man's house if he does not want it?—I do not know.

6281. Do they ever do it?—No. My former answer about writing to the Municipal Secretary is relevant to latrines only.

6282. (*The President.*)—Not to ventilation or openings in the houses?—No.

6283. Supposing the ventilation is altogether defective, do you consider it your function to report it?—I should think it is within my functions, but I do not think it can be carried out. They do not build on any principle whatever.

6284. As a matter of fact when you see the houses badly ventilated, what steps do you take?—I take no steps beyond advising the owner of the house.

6285. With regard to the incidence of plague, did you find it bear any relationship to the character of the houses?—No.

(Witness withdrew.)

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Date of evacuation.	Locality.	Total number of persons turned out of their houses.	Attacks in town up to date of evacuation.	Deaths in town up to date of evacuation.	Number evacuated who went to (a) Observation camp.	(b) Segregation camp.	(c) Private camp.	Attacks among (a)	Attacks among (b)	Attacks among (c)	Deaths among (a)	Deaths among (b)	Deaths among (c)
		About											
22nd November 1898	Infected portion of Jagannath Muhalla called A.	1,000	24	19	356	81	563	...	1	1	...	1	1
24th November 1898	Immediate neighbourhood of a house in Jagannath B.	50	31	24	20	19	11	1	1	...	...	1	...
25th November 1898	Immediate neighbourhood of a house in Marotee Muhalla.	50	37	27	22	6	22	...	1	...	...	...	...
29th November 1898	A private camp	15	39	30	10	5	...	...	...	...	...	...	...
2nd December 1898	Jagannath Muhalla B and immediate neighbourhood of a house in Ram Chand Muhalla.	400	45	33	178	22	200	2	...	...	1	...	...
4th December 1898	Immediate neighbourhood of a house in Santan Muhalla.	80	48	33	66	14	...	...	1	...	...	...	...
6th December 1898	Santan Muhalla and part of Khandoba Muhalla.	400	53	35	159	12	223	...	2	...	...	1	...
8th December 1898	Jagannath C and a private camp of residents of above.	50	57	40	18	32	...	...	5	...	...	4	...
13th December 1898	Parts of Dangri and Khandoba Muhallas	500	68	49	284	15	207	1	...	5	...	...	1
14th December 1898	Parts of Rangari Muhalla	200	73	53	89	11	100	...	1	1	...	1	...
19th December 1898	Whole of Rangari Muhalla	400	87	67	251	37	112	1	1	4	...	1	3
21st December 1898	Whole of old town	1,500	100	72	900	52	548	1	2	3	1	2	...

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Wardha.

Date of evacuation.	Locality.	Total number of persons turned out of their houses.	Attacks in town up to date of evacuation.	Deaths in town up to date of evacuation.	Number evacuated who went to (a) Observation camp.	Number evacuated who went to (b) Segregation camp.	Number evacuated who went to (c) Private camp.	Attacks among (a)	Attacks among (b)	Attacks among (c)	Deaths among (a)	Deaths among (b)	Deaths among (c)
6th December 1898 . .	Infected locality of Mahadeo and Patel puras.	About 500	2	2	96	18	386	...	...	...	...	...	...
8th December 1898 . .	Immediate neighbourhood of a house infected in Brahminpura.	300	4	2	48	1	251	...	...	...	...	...	...
10th December 1888 . .	Immediate neighbourhood of a house infected in Malguzaripura.	300	6	4	52	20	228	...	...	...	...	...	...
12th December 1898 . .	Immediate neighbourhood of Muhammadan School in Wanipura and a house in Malguzaripura.	28	8	4	25	3	...	...	...	...	...	...	...
14th December 1898 . .	Immediate neighbourhood of a house in Mahadeopura and Patelpura.	100	11	6	9	4	87	...	...	1	...	...	...
15th December 1898 . .	Immediate neighbourhood of houses in Mahadeo and Brahminpura and two private camps.	200	15	7	59	32	109	...	...	2	...	...	1
16th December 1898 . .	3 private camps	30	18	10	...	2	28	...	...	1	...	...	1
17th December 1898 . .	A private camp	9	19	13	...	9	...	...	...	...	...	...	...
19th December 1898 . .	Ditto	5	20	15	...	5	...	...	...	...	...	...	...
20th December 1898 . .	Ditto	6	22	18	...	6	...	...	1	...	...	1	...
21st December 1898 . .	*Nil*												
22nd December 1898 . .	*Nil*												

Lieutenant F. A. L. Hammond, I.M.S., called and examined.

Lieutenant F. A. L. Hammond.

22nd Dec. 1898.

6286. (*The President.*)—What are your medical qualifications?—Member of the College of Surgeons and Licentiate of the College of Physicians.

6287. What is your official position here?—I am Inspecting Medical Officer.

6288. What do you know of the origin of plague?—The history of the outbreak of fever and its mortality previons to my arrival, starting from the 10th November, is detailed in the report of Mr. Hogan, Civil Surgeon of Wardha; the fact of the cases being confined to a small and circumscribed locality and the circumstance of dead rats having been found appeared to establish evidence of the presence of plague without enquiry into the cases themselves. On the morning of the 20th ultimo, accompanied by Mr. Hogan, I visited 18 cases of fever, and came to the conclusion that the majority of these were genuine cases of plague of virulent type.

6289. Where were the cases situated?—All the cases were situated in the Jugannath Muhalla which is from a quarter to half a mile square, bounded on the north by the Dispensary Road, on the south by the Kirana Road, on the east by the Tahsili Road, and on the west by the main road running through the town. The houses in this locality, or rather hovels, are very cramped together, badly lighted and ventilated. The population of the Muhalla is approximately 1,000, and it is inhabited largely by mill employees. The majority of cases occurred amongst mill-hands or their relatives.

6290. Were the cases grouped round certain centres of infection?—Yes, the cases were apparently grouped round three separate centres of infection: (1) The house of Nagunna and three or four houses in the immediate vicinity; (2) the house of Jairam and its environments, and (3) the house of Unkar. On the afternoon of the 20th I again visited the infected area and saw three fresh cases which had occurred since my arrival. Two of the cases were in the neighbourhood of Nagunna's house. The other case was a Marwari, Hari Ram, 18 years of age, and was situated on the main road but in the opposite Muhalla. His master, a Marwari, had died in this house two days previously. All three cases presented typical appearances and symptoms of bubonic plague. In the house of Nagunna there were three patients,—himself, his wife, and his mother. All were suffering from high fever with glandular enlargements. Nagunna himself presented the appearance of a case of typical plague. In the house of Jairam where two deaths from fever had occurred previous to my arrival, there were four patients, three of whom had fever whilst the fourth was moribund with sub-normal temperature. In Unkar's house was one female, with a history of fever for six days, who was moribund. Three deaths had occurred in this house since the 13th ultimo, one a child, having died the day before my visit (*i.e.*, on the 19th). One man who originally resided in this house died, making five deaths in all. The remainder of the cases were in the vicinity of Nagunna's house.

6291. I think you can give us a summary of the cases from your case-book?—Yes. The first case was in the house of Ram Chunder, a female, Wasta, age 30, who was reported to us to have died during the night of the 19th. The mill Hospital Assistant who was in attendance stated that her temperature on the 19th was 104° F. and that the glands in the thigh were enlarged. Permission was only given to inspect the corpse. A large red œdematous swelling was noticed in the right inguinal region. The second case was that of a man named Nagunna in his own house, a Madrasee, suffering from fever for four days, appearance drowsy but is intelligent. Tongue furred. Pulse 120, very weak. Temperature 9-30 a. m. 103° F. suffering from slight diarrhœa. Pain in the back and head severe. Large inflamed painful swelling in the left groin in which enlarged indurated glands could be distinctly felt. 4-30 P.M. temperature 99·4° F. Pulse 100. Resp. 20. A diagnosis of plague was made and confirmed by bacteriological examination. The next case was that of Runga Amma, 36, female, wife of Nagunna. Taken ill on the 19th. Temperature 101·6. Tongue furred and spotted. Pulse 140, weak. Small inflamed gland in right groin, severe headache. Plague diagnosed. Died on night of 20th. Then there was the case of Tazia Amma, 60, female, mother of Nagunna. Fever for three days. Looks very ill, has suffered from obscure abdominal complaint for years. Temperature 101·8. Tongue furred. Pulse 100 full. Small painful swelling in left axilla. Died on night of 20th. Case No. 5, was that of Pandurang Withal who was seen in his own house which was next door to Nagunna's, 25, male, Brahman, a timekeeper in the mills. Suffered from fever since 8th instant. Glands have been enlarged on right side of neck but are now almost well. Is convalescent. Lives next door to Nagunna and is the probable source of infection for this area. The next case was in the house of Sheik Guffoor, that of Amminabi, female, 6 years, daughter of Sheik Guffioor, chaukidar in the mills. Has had fever 12 days. Is now intelligent but is said to have been delirious yesterday. Temperature 105 2 (said yesterday to have been 108·06). Tongue foul. Pulse 168. Small, very painful, gland in right groin. The next case was seen in the house of Jairam. There had already been three deaths from fever in this house and four were found to be suffering from fever on our arrival. Kashinath, male, 35. Drowsy vacant expression. Pulse 120 full and bounding. Tongue slightly furred. Temperature 104° (at 5-30 p m. 103°). Marked crepitations over whole of right lung. Slight enlargement of glands in right femoral region. Pneumonic plague diagnosed. Confirmed by bacteriological observation. The next case was seen in Sibaram Haliva's house, Jibli, 23, female, Marwari. History of fever for three days. No fever on inspection and is apparently healthy and cheerful, but died on the night of 20th.

6292. Did you make any bacteriological examination?—Blood was taken from the finger of Nagunna and from Kashinath who was suffering from severe fever of a pneumonic type in Jairam's house. An incision was also made in the glandular enlargement in the case of Nagunna and material collected for examination. On microscopical examination a few plague bacilli could be seen in the blood specimen. Cultivations were made for 24 hours and presented the appearance of typical colonies of plague bacilli. Microscopical preparations from these colonies showed typical bacilli of bubonic plague.

6293. Have you any remarks to make upon the outbreak of plague?—Yes. The earliest case of which there is any record is Pandurang Withal, a timekeeper in the Hinganghat Mill. He states that he has been ill since 8th instant but he is now free from fever and apparently convalescent. The glands on the right side of the neck have been swollen and suppurating, but are now healed. He lives next door to Nagunna and has apparently been the source of infection to the houses immediately round. How he himself contracted the disease is uncertain. Four men have come from Bombay during the month (on the 4th). They were in good health on the 10th instant. This is according to the Police statement, but is probably inaccurate and needs confirmation. The disease is, with the exception of one case, the Marwari Hari Ram, confined entirely to the Jugannath Muhalla which is being evacuated.

6294. (*Prof. Wright.*)—Were any rats sent to you for bacteriological examination?—Not in Hinganghat; they were sent but I never got them.

6295. Have you made any other bacteriological observations?—I have, in Nagpur.

6296. Had the timekeeper in the Hinganghat Mills come from Bombay?—No; he had infected himself at Hinganghat.

6297. Was there any history of his having been in connection with any one who had plague?—No, except that he was in the Mills and all the people were new hands.

6298. Have you done any inoculations?—Yes, in Nagpur.

6299. But none here?—No.

6300. Will you tell us about the prophylactic?—I obtained a box at Hinganghat when I was there.

6301. Where did you get it?—Fresh from the laboratory at Bombay. Mr. Hogan inoculated himself and the Hospital Assistant there, and they were both so ill and I decided to look at the vaccine rather carefully.

6302. What dose did they take?—I did not ask. He told me that he had erysipelas of the arm, and he was very bad, and the Hospital Assistant was extremely ill.

6303. Did you see the arm?—No; I was in Nagpur at the time. I looked at this fluid, and there was a thick white precipitate in it which looked bad. The precipitate stuck to the side of the bottle. It did not seem the same as the ordinary stuff sent out, so I decided not to use it.

6304. You have seen a good number of those bottles of prophylactic?—Yes.

6305. You think this particular lot differed from those which you had seen before?—Yes, there was a much more excessive precipitate and it was growing in it and stuck to the side of the bottle.

Lieutenant F. A. L. Hammond.

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6306. Do you remember the doses on the bottles?—They varied. There were two different brews, one dose was 10 c.c. and the other 7½ c.c. I think, but I am not certain.

6307. Did you make a bacteriological examination of these?—Yes.

6308. Both brews, or only one?—I did not notice; I think I only examined one brew.

6309. Did you examine more than one bottle?—I examined three bottles and I sent three bottles up to Bombay ten days ago asking if they were fit for use, but I have had no answer, so I decided not to use that brew at all.

6310. You examined three bottles?—Yes.

6311. Did you see they were properly sealed and corked?—They were properly sealed at any rate.

6312. What did you do in the way of examining them bacteriologically?—I took the cork out antiseptically, poured out the fluid and examined first of all some of the precipitate under the microscope. The bacilli were not motile at all. A number of bacilli were arranged in clumps. I put it on agar but it did not grow. I fancy it was sterile. I got no culture at all.

6313. Did you put much fluid on your agar or only a drop?—I put a good deal.

6314. You did not dilute it beforehand to get rid of the antiseptic?—There was no antiseptic.

6315. But we have Professor Haffkine's statement that there was always antiseptic in the bottle?—I am afraid I did not have it. There is some I did yesterday still incubating.

6316. You made an examination on three bottles on agar and found them all sterile?—Yes.

6317. And examining them under the microscope you saw bacteria but you did not see any motile forms?—That is so.

6318. Did you do any inoculations with this yourself?—Not with that particular brew, but with other brews.

6319. Have you seen any bad symptoms result from these inoculations?—Yes, my own Hospital Assistant had severe induration of the arm which extended almost to the elbow. I do not know whether that was more than the ordinary reaction.

6320. Have you done many of these inoculations?—Seventy-one.

6321. Did you always give the dose on the bottle or did you dose the patient yourself?—I gave the dose on the bottle varying it according to physique.

6322. Were there any instructions given on the bottles?—Yes.

6323. Did these instructions state that a certain definite degree of fever ought to be produced by the inoculations?—No, only the ordinary instructions Professor Haffkine issues.

6324. Do these instructions deal with the method of drawing the corks and the method of sterilising the syringe and the variation of the dose in accordance with age and sex? Have you any observations bearing on the protective power of these inoculations?—We have had no plague in Nagpur, so I cannot say. One rather interesting point was that I inoculated a batch of thirteen of the medical men in Nagpur and the only two who did not react were Europeans.

6325. Did you give them the same dose?—Yes.

6326. Did you shake up the bottle before you gave it to them?—Yes.

6327. You think they got exactly the same sort of material?—Yes.

6328. Have you any other bacteriological facts you would like to mention?—I think that this prophylactic fluid is very variable with regard to the difference in reactions in various bottles. For instance, the very first inoculated with, no one had any reaction at all.

6329. Do you find the different bottles of the same brew vary between themselves?—I have not noticed that.

6330. But in the different brews have you found great variety?—Yes, I found great variety and so has the other doctor who inoculated before me, Dr. Row. One bottle will give a reaction amongst all the people inoculated with it and the next bottle will give none at all. It also varies with the inoculator. The native doctor, Dr. Row, did ninety-five cases of which there is a record of eighty-five; there were forty definite reactions and two were doubtful, about forty-nine per cent. I did seventy-one cases of which there is a record of fifty, and out of those fifty there were forty-six reactions; nearly all the people reacted. The reason we have not the record of the others is that they have not come back to the mills to work yet, probably they are ill.

6331. Do you know Dr. Row?—Yes.

6332. Did he give the full doses?—Yes; they are down here in the book.

6333. The difference may be due to different material, may it not?—I used the same material.

6334. You used different bottles I presume?—Yes, but probably the same brew—at any rate it was the same consignment.

6335. Did you ever get too severe a reaction?—No. The only one I have seen was my own Hospital Assistant which was severe. I have only heard of them.

6336. What chance have you of finding out whether a man has too severe a reaction? Do you see him the next day?—They are requested to report and their temperatures are taken.

6337. How many of the seventy which you have done have reported themselves?—We have a record of fifty of them, some I have seen myself and in others the temperature has been taken by the Hospital Assistant.

6338. You are able to say that you have not seen an excessive reaction?—Yes.

6339. You would have seen it probably if it had occurred?—Yes.

6340. What about these twenty who have not reported themselves; do you think they are sick?—They have not returned to the mill to work; the probability is they are too ill to go.

6341. (*Mr. Hewett.*)—Professor Haffkine's instructions contain certain directions with regard to the reaction which should be obtained?—I think they say the temperature should be 102° to be of use.

6342. How many of these people went above 102°?—I can make that out but these cases have been recent.

6343. Perhaps you can tabulate the facts as to all of them?—I think I could. They live in the bazar. They have not returned to work and I have not been able to ascertain.

6344. (*Prof. Wright.*)—Certain cases give a small reaction; could you put your observation in such a form that we should know what amount of reaction was produced by each individual bottle?—I think we have the bottles, and the brews are on the counterfoil.

6345. (*The President.*)—You have the actual temperatures I understand?—Yes.

6346. (*Prof. Wright.*)—The point is that certain sequences will have small reactions and other sequences high reaction?—Fourteen of those twenty-four are over 102 and some of the others 101½.

6347. (*The President.*)—What is the minimum reaction?—The minimum here is 100·8.

6348. (*Dr. Ruffer.*)—Were they all taken at the same time?—These were all done in one morning.

6349. Exactly at the same time after the inoculation?—That I cannot say.

6350. (*Prof. Wright.*)—In some cases you said you had a series which gave no reaction?—That is only part of them.

6351. That statement is based on your observations in Nagpur as well as here?—These are purely Nagpur.

6352. What are your statements that sometimes you gave a bottle and got no reactions based upon?—They are based upon the man who preceded me in Nagpur and my own observations; going by this book the first eight here had no reaction at all.

6353. But that has not come under your personal observation?—No.

6354. (*The President.*)—You had better distinguish them?—I will.

6355. (*Prof. Wright.*)—Has it ever occurred in your own personal observation?—Yes my own, as well as my predecessor's. By going through the book I find the list of reactions and those which do not react, but sometimes there is a column of nine or ten who have not re-acted and then the next have.

6356. Can you pick us out those cases and make a table to show that sometimes you have been giving the full dose on the bottle and have got no reaction?—Yes.

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6357. Will you tabulate the evidence on which you make that statement?—Yes.

6358. (*Dr. Ruffer.*)—With regard to your bacteriological examination, did you look for ærobic organisms and not for anærobic organisms?—That is so.

6359. I think you said the contents of the bottles were rather gummy?—Yes.

6360. Were the dead bacteria which you saw in the fluid like plague microbes?—They were plague microbes I think, but some of them were rather longer.

6361. With regard to the assistant who was so ill after inoculation, could you give us some details as to what occurred to him?—I am not quite certain that it did not bring on an attack of malaria. It is a doubtful point because every evening his temperature went up to 102·8 or 103. I think inoculation will do that.

6362. What is the highest temperature he reached?—103.

6363. How long after the inoculation?—A day and a night.

6364. And locally?—Locally he had marked induration which extended to the elbow.

6365. How long did that last?—It has not gone down yet.

6366. How long ago has the inoculation been done?—About five days.

6367. Did he get enlarged glands in the axilla?—No.

6368. Then he had fairly severe general symptoms?—Yes.

6369. And fairly severe local symptoms?—Yes.

6370. You have had no deaths among the inoculated?—No.

6371. (*The President.*)—With regard to this man who became very ill, had he had malaria before?—Yes.

6372. I suppose the temperatures are only taken once?—They are taken the next morning.

6373. Have you any record of the interval between inoculation and the time at which the temperature is taken?—I have in one series of cases where I inoculated the students of the Medical Missionary College of Nagpur: the temperatures were taken every four hours.

6374. But in the great majority of cases it has not been taken?—No.

6375. (*Dr. Ruffer.*)—Could we have those temperatures and a chart of each case if possible?—Yes.*

(Witness withdrew.)

MR. HOGAN recalled and further examined.

Mr. Hogan.

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6376. (*The President.*)—We wish to ask you a little more about another point. We have been told that you have been inoculated?—Yes.

6377. When was that?—On the 27th November.

6378. Who did it?—Assistant-Surgeon Sirkar.

6379. Whom did the fluid come from?—From M. Haffkine; I telegraphed to him.

6380. Was it opened for you?—Yes.

6381. What was the result of this inoculation?—For the first three hours I got a tingling pain right down to my wrist from the puncture; I was inoculated on the back of the arm above the elbow. That is a most awkward place to do it, but that is according to Professor Haffkine's instructions. I was down about 5 in the evening. At 9 o'clock I began to feel feverish. About 11 o'clock that night my temperature went up to 102. I had fever, I am always a bad fever patient. They say I was making a great noise. I had four men shampooing me all night and the Sub-divisional Officer living next door said I was very troublesome all night, but I do not remember that.

6382. You went off your head?—I do not know whether I went off my head or did it in my sleep. I am a very bad patient with fever. I remember up to 11 o'clock only. At 9 the next morning I came up here in a trolly still feeling feverish and my arm was still painful.

6383. Was your temperature taken?—No, I was at work. I had a painful arm and the pain continued for eight or nine days. With regard to the induration, on the 15th day I made the Commissioner feel my arm; about six inches round the puncture was inflamed and swollen. I thought I was getting an abscess, and asked the Assistant-Surgeon to feel it, but he said it was not an abscess.

6384. How much of the arm swelled?—The erythema came down to the knuckles and swelling extended from the shoulder right down to the wrist, and I had to keep my arm in a sling.

6385. Were the glands at all swollen?—I do not think so.

6386. Have you been inoculated again?—No; I got 9½ c.c and that nearly corpsed me.

6387. (*Prof. Wright.*)—Did Assistant-Surgeon Sirkar who was inoculated with you suffer very much?—He suffered the first day less than I did. He told the Deputy Commissioner that "The Civil Medical Officer is an old chap; I have resisted the action of the fluid", but after 24 hours he did not work for two days. He said "If there is an antidote to the Haffkine poison send it down at once; I want it to-night." I said "Will you ask me now where are my powers of resistance?" The man was down for about seven days afterwards and for three days he did no work.

6388. Did he get a temperature?—105·6 he says was the highest. He lay in bed and had plenty of time to take his temperature; he has a regular record of it.

6389. Did you see anything unusual in any of the bottles?—There was a deposit but I understand it was all right. Professer Haffkine's instructions were to shake it well up and to open it with antiseptic precautions and sterilise it.

6390. Did you use the bottle on anybody else?—No. Professor Haffkine's instructions are that you must not use it again. Only myself and this unfortunate Assistant Surgeon were inoculated with it. We destroyed the remainder.

6391. (*Mr. Hewett.*)—Did you give him 9½ c. c.?—I gave him 10 c. c. to the drop. I do not know whether he got nervous, but I was told that when he removed the syringe a few drops escaped from it, but I gave him the full 10 c. c. to the drop.

6392. You gave him the dose put on the bottle?—Yes. 2¼ c. c. is the dose Haffkine says. The instructions on the bottle are to be followed and in that case four times the dose was to be given.

(Witness withdrew.)

MR. MOHAN LAL called and examined.

Mr. Mohan Lal.

22nd Dec. 1898.

(Witness's replies translated by the Secretary.)

6393. (*The President.*)—You saw some of the plague cases I believe at Hinganghat?—Yes.

6394. Did you see the very first case?—Yes.

6395. Where did that first case occur?—I first inspected the house of one Krishna on the 11th November 1898, and I reported the case to Mr. Hogan.

6396. When?—On the same date.

6397. Before that did you see any cases which were at all suspicious?—Fifteen days before that I noticed two cases. I was going along the road when I saw a man with his hand upon his groin and he asked me to look at him. I found no plague symptoms in him. The man was under treatment for bubo by the doctor who attended the mill hands. The other man I also saw wandering about, and he said he had a swelling in his groin and asked me to look at it. I was going to see another patient and I told him to

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* See Appendix No. XIX in this Volume. The charts submitted are not published in these Proceedings except in 3 cases.

Mr Mohan Lal.

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come to the hospital and I would examine him, but he never came.

6398. Did you ever see these two men again?—Not as a doctor, but they are still alive. I had no suspicion then that it was plague, but after the 1st of November when I heard there were deaths among rats I began to get suspicious.

6399. What else did you look for besides the bubo in this man?—I did not touch him or examine him thoroughly at all; I simply saw him from a distance.

6400. Can you tell me about the case of Pandurang Withal?—Yes. Mr. Hogan was with me when I saw this man. He had a sore throat. Lieutenant Hammond examined him but I did not examine him. I looked at him from a distance. I saw him on the 18th November when he was well and he remained in the hospital camp well, and he is still well. He had been ill but had got well.

6401. Had you ever seen a case of plague before?—No.

6402. Did you know the symptoms?—Yes, I knew the symptoms from having read them in a circular that was issued.

(Witness withdrew.)

(Adjourned till Thursday, December 29th, at Calcutta.)

At The Home Office, Calcutta.

NINETEENTH DAY.

Thursday, 29th December, 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

COLONEL T. H. HENDLEY, C.I.E., I.M.S., called and examined.

Colonel T. H Hendley.

29th Dec. 1898.

6403. (*The President*).—I believe you are Inspector General of Civil Hospitals, Bengal, and Officiating President of the Plague Commission, Bengal?—Yes.

6404. I think you have seen some plague in Jeypur?—Yes, one case of plague in Jeypur.

6405. I think you had charge of some administrative measures there?—Yes, I was in executive charge of Jeypur, and administrative medical charge of the whole province of Rajputana.

6406. You saw some plague there?—The Jeypur case.

6407. Only one case?—Yes.

6408. Where did it come from as far as you know?—From Bombay.

6409. You clearly traced it from Bombay?—It came by rail. The man I saw was in a moribund condition.

6410. When was that?—About Christmas Day, 1896.

6411. I think you left that district?—Yes, I left Rajputana in the following February, 1897.

6412. And you returned, I think, in December of the same year?—Yes, at the end of 1897.

6413. You then found plague in certain villages?—Yes, about Mount Abu.

6414. How do you think it had been introduced into that district?—By Banniahs, who had come from Poona to their home in Palanpur and Sirohi, a small State in which Mount Abu is situated. Plague was prevailing at Palanpur across the border of the Bombay Presidency. It was not thought that the cases in these villages were introduced from Palanpur, but was brought by the Banniahs who lived in the villages near Mount Abu, and who came from Poona where plague was raging at the time.

6415. I believe you were struck with the resemblance between these cases and the Mahamari or Pali plague?—The plague occurred in Pali, about 40 miles to the north of these villages in Sirohi in the Jodhpur State, the great mercantile capital of the west of India from time immemorial. There was plague there in 1836, and it also spread to Jodhpur. I obtained a copy of the letter which was written by Assistant Surgeon Maclean, who investigated the case, and I sent it to the officer who was then on duty in the plague camps in the Sirohi villages, and he noted on the margin the points of the resemblance between the plague of 61 years previously, and the late epidemic.

6416. Had you yourself seen any of this Pali or Mahamari plague?—No case had occurred since 1836.

6417. You only talk of the observation of others?—By the notes made by this officer at the time.

6418. You know the district?—Yes.

6419. Could you give us a description of this district?—Pali is a large town near Marwar Junction. I was Residency Surgeon of that district at Jodhpur in 1872, and a great many of the trade routes converged on this point, so that it was a point at which disease of an epidemic nature was likely to break out. The whole country is a sandy tract and is generally called the Marwar part of the western desert of India. This particular town stands in the midst of the sand. The town itself is an extremely filthy place. There are a number of dirty tanks. It is inhabited by Banniahs or dealers in cloth, principally in piece goods, and also dyers of piece goods. It was supposed that the plague of 1836 was brought from Gujarat through Sirohi and Marwar in these piece goods. It broke out amongst the dealers and dyers, and, as on the present occasion, people fled in all directions.

6420. Are the houses aggregated into large villages, or scattered pretty well?—Pali is a large town; but the villages generally are some distance from each other in Marwar.

6421. Can you give us a description of the houses themselves?—There are a large number of stone houses in Pali, but there are also a great many streets consisting of mud houses having thatched and tiled roofs. The villages generally consist of a few houses made of stone which belong to the principal men in the village, and the rest are huts, with narrow lanes and perhaps a dirty tank. There is not always a tank because water is very scarce in Marwar.

6422. How many chambers are there in the house generally?—The huts very rarely have an upper storey. Some of the houses have two storeys, but the huts very rarely have two storeys. As far as I recollect in Pali there are a few large houses of stone because it is a wealthy place.

6423. Are the cattle kept separate from the houses, or are they in the houses?—The cattle are driven out during the day, and brought into Pali during the night, as is the case in other villages in the desert. They generally are part of one enclosure as also are the rooms in which the people live: the huts are on one side, and the enclosure for the cattle on the other.

6424. What sort of water-supply do you say these villages or towns have there?—Some of them have tanks but very few of them. Generally there is a well.

6425. Are the tanks protected or polluted?—They are subject to every kind of pollution. The cattle bathe in them, and the men and women too, and they draw their drinking-water from the tanks.

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6426. I think you afterwards became Inspector-General of the Civil Hospitals ?—In the North-West Provinces.

6427. And subsequently in Bengal ?—Subsequently in Bengal.

6428. And since April you have been officiating as the President of the Plague Commission ?—I have been Inspector General since April, and Officiating President of the Plague Commission since August. Practically I have been doing plague work since April.

6429. Therefore I suppose you are familiar with the occurrence of plague in Bengal itself ?—Yes.

6430. Can you give us a short sketch of its introduction here, and the extent to which it has prevailed in the Presidency ?—I arrived here on the 8th of April. The first case of plague which was definitely reported as such in Calcutta occurred on Sunday, 17th April, and I, on that date, accompanied Dr. Cook, the Health Officer, and the Sanitary Commissioner, to examine the house in which it occurred. I saw what had been done towards investigating the case. The house was thoroughly disinfected. Since that time I have seen cases at the Medical College, and as far as my knowledge and experience of tropical disease,—which extends over twenty-eight years, during many of which I have been in charge of a large hospital—go, I have met with no disorder which resembles these cases, and can only come to one conclusion that they were cases of true plague.

6431. Of course you had anticipated this invasion of plague ?—Undoubtedly, because before my time all arrangements were made for the prevention of it.

6432. And since you came here you have simply carried on the measures which had been inaugurated for you ?—They were modified as occasion required, of course.

6433. Have you had any experience with regard to inoculation in connection with the plague ?—Not personally.

6434. Have you so far studied the matter as to be able to form an opinion as to what is the exact manner in which plague is carried from one place to another, and what it is carried by ; human agency or articles ?—I believe it may be carried in both ways, by human agency, and by clothing. I have reason to believe that it is carried as much by clothing as by human agency.

6435. Have you any instance in which clothing appears to have carried plague from one place to another ?—I think at Hardwar it was brought in clothing in the first case. We traced it in the case of pilgrims who brought the disease with them. I was at Hardwar when the first case broke out ;—it was that of a woman who was an attendant in a lodging house frequented by Sikhs, and those Sikhs themselves, as far as we knew, were not affected with plague. We had no direct evidence to show that it was brought in their clothing, but that was the only explanation we could give.

6436. It was merely the impression produced in your mind ?—That is so.

6437. As to the treatment of any district where plague has occurred, you have had a great deal of experience, I suppose, in Calcutta and elsewhere ?—I have had experience in Calcutta.

6438. What measures do you find most expedient ?—Thorough evacuation of the houses, as far as possible ; and thorough disinfection and cleansing. We came to the conclusion that if the people were driven out at once, plague would be spread over the district, and we would not be able to follow the people.

6439. What measures have you adopted here in the way of disinfection ?—Different measures. Generally thoroughly washing the place, lime washing, cleansing the soil, and disinfecting with perchloride of mercury.

6440. The interior of the houses ?—Yes.

6441. Do you remove the soil from the floors of the dwellings ?—It has not been practicable as a rule.

6442. Why ?—It was not practicable with stone floors. We have had the stone floors thoroughly washed. If the floors had been of earth, we should have removed them.

6443. You have not many houses with earth floors ?—Not in the masonry houses.

6444. In the smaller houses ?—In the bustee houses.

6445. Have you encountered much difficulty in isolating, or removing people ?—There has been great difficulty indeed. There was great opposition at one time ; and even now I do not think very active measures could be taken.

6446. There has been a great exodus from Calcutta ? —There was an extraordinary exodus at the time.

6447. Was that for fear of plague, or for fear of the measures that were about to be adopted ?—The people knew not for what : they exaggerated everything that was done. False rumours of all kinds were afloat, especially among the women : they were afraid they would be killed or poisoned. But there are so many different reports that it is impossible to put the fear down to any one of them.

6448. I suppose there are villages which you have evacuated in Bengal ?—Plague broke out in a village a short distance from Barisal which is surrounded by water. It was possible there to isolate the people on a country boat and to cut off the houses by simply drawing back the planks or trees by which the people approach their houses, over these small water cuttings.

6449. You prevented them from going back ?—Yes. They were prevented from going back.

6450. What is the largest village which you have attempted to evacuate ?—Plague has only occurred here in this one centre outside Calcutta, near Barisal.

6451. Have you anything to tell us as to the propagation by rats, from your own observation ?—At the time the first case broke out rats were observed to be dying in large numbers in the East Indian Railway Printing Department,—on the ground floor ; and from day to day further reports were made, and several cases were traced from amongst the printers and their relations, of plague which occurred in Calcutta. The persons attacked died. There were other cases of rats which were found in the godowns or stores of a large firm, Messrs. Mackenzie Lyall & Co., close by on the other side of the road.

6452. So far as you know did dead rats occur before the first case happened ?—About the same time.

6453. You do not know which preceded the other, do you ? —I think that is given in Dr. Cook's note. I rather think it was before.

6454. It is not your own observation ?—I cannot exactly remember. There were so many things occurring at the time.

(Witness withdrew.)

The following questions were sent subsequently to witness and his answers to them were submitted by him on the 4th of March 1899 :—

6455. Has anything been done, since Calcutta was declared free from plague on 10th October last, in the way of examining the passengers and crews of vessels which are proceeding to Europe ?—The crews and passengers of all vessels bound to European ports have been examined as laid down in Plague Regulation, No. 14, dated the 2nd May 1898. This Regulation prescribed that no vessel should leave Calcutta for any port out of India, or for Rangoon, Aden, or any Madras Port, without a bill of health granted by the Port Health Officer. It provided for the inspection of everybody on shore by day by the Health Officer before embarkation ; should any one be found suffering from plague or considered not to be free from infection, he would be retained under observation. All contaminated and suspected articles had to be thoroughly disinfected on shore by steam, or by the application of a 1 in 1,000 solution of corrosive sublimate or a 5 per cent. solution of carbolic acid.

6456. What arrangements are actually in force at the present time ?—Since the receipt of Resolution No. 1145 Medical in the *Calcutta Gazette* Extraordinary of the 25th February 1899 the examination of crews and passengers is carried out on shore. This is the notification by which Calcutta has lately been again declared infected, and the fourth paragraph runs as follows :—

"4. In these circumstances the Lieutenant-Governor is compelled, with much regret, to re-impose the restrictions which were withdrawn in October 1898. A Resolution is under issue prescribing that the inspection of the passengers and crews of vessels leaving Calcutta for ports out of India shall again be conducted by day on shore at the time of embarkation, and the fact that this has been done will be endorsed on the bill of health to be granted before any such vessel leaves the port. Correspondence has recently passed regarding a proposal that the clothing of the crews and deck passengers of vessels proceeding on long voyages shall be disinfected before departure. The Lieutenant-Governor was at first in hopes that this measure might not be necessary, but in view of the altered condition of things this is no longer possible. In communication with the Liners' Conference and the late President of the Chamber of Commerce, he has drawn up a scheme to give effect to the proposal, and arrangements will be made to bring it into force as soon as the apparatus can be procured."

Dr. J. Nield Cook called and examined.

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6457. (*The President.*)—You are the Health Officer of the Corporation of Calcutta?—Yes.

6458. I suppose you have been generally in charge of all the plague operations in the city?—Under the Chairman of the Corporation.

6459. You are the executive officer?—Yes, up to the 22nd or 23rd of July, not after that.

6460. How long have you been in charge of these operations; what was the date of your appointment?—The commencement of the year. I arrived here on the 2nd or 3rd of January.

6461. When was the first case of plague brought to your notice?—I think it was the 17th of April.

6462. Will you give us some details as to this case?—Yes. I will read the report I made at the time to the Chairman of the Corporation:—"I was called up at 2-30 A.M. on Sunday morning, the 17th April, by the Inspector of Police, Bow Bazar, and accompanied him to Kapalitola Lane. There I saw the dead body of a man in a kutcha-built modi shop, where ghee and a few other comestibles were sold. The deceased appeared to be about 30, and was a fine strong man. He had a left femoral bubo presenting the characteristic appearances of a plague bubo. One man, his brother, was with him. The Police sent the body to the Morgue, and I roughly disinfected the place with disinfectants which I had brought with me. At 8 A.M. Surgeon-Major Dyson, the Sanitary Commissioner, and I attended the *post-mortem* examination made by Surgeon-Major Gibbons, the Police Surgeon. There were large extravasations of blood extending from the affected gland upwards and downwards: also small extravasations on the heart, bowels, etc. These appearances are very characteristic of plague. The signs generally pointed to death from an acute blood poisoning, probably plague. I made bacteriological cultures and will report the results. The deceased had not left Calcutta for some time, and the source of his infection could not be traced. The history of the case as I got it was as follows. The deceased passed Thursday night at the house of a woman. On Friday he returned home and went out as usual to hawk ghee. He returned at 11-30 A.M. somewhat earlier than usual, and took his meals, though he complained of pain in the groin, and feeling unwell. At 1 P.M. the pain was worse, and he had a shivering fit (rigor), not followed by sweating. The fever increased and became very severe. He was very restless and tossed about on his bed. He complained once that his heart was bursting. He took some milk with sago that was given him. On Saturday morning he was unconscious, and remained so till 10-30 P.M. when he died."

6463. Who did you say made the *post mortem* examination?—Major Gibbons.

6464. I think it was a typical case of plague?—Absolutely typical. I have never seen a *post mortem* appearance anything like it in any disease except plague.

6465. And the bacteriological diagnosis confirmed it?—It worked out perfectly straightforwardly. I had no doubt at all about it.

6466. Before this there had been a case admitted into the Medical College Hospital, I believe; had there not?—Yes; but I think the officer of that Hospital will be able to give you full information with regard to those cases. I did not see or hear of them until after this case.

6467. You have no doubt that that was a case of plague?—Not the slightest: I could swear to it.

6468. The point is rather important. The epidemic among rats broke out on what date?—I first heard of it a week or ten days before this. I received a letter on the 15th; but they had been finding rats for a week before they wrote to me.

6469. So that it is doubtful whether the epidemic appeared first among rats, or among men?—Yes.

6470. Probably it appeared first among men?—Yes.

6471. The first diagnosed case of plague was admitted into the hospital on the 31st of March, was it not?—That was not diagnosed as plague.

6472. It was diagnosed as plague afterwards?—Yes.

6473. It was a case of plague?—I think so.

6474. And the first notification of rats dying was on the 15th of April?—Yes.

6475. Although on the 15th of April I believe it was stated in the letter that the rats had been dying for a week?—Yes.

6476. The first man who died, died in Kapalitola Lane: is that anywhere near?—Not very near; I should think it would be about a mile.

6477. You trace no connection between this case and rats?—There are a number of people who work at the jetties living in Kapalitola Lane, though this man had not done so. I do not know but what there may have been some other case before, which I have no knowledge of.

6478. This man had not been to Bombay, or out of Calcutta?—Not out of Calcutta for some months, at any rate.

6479. There were some people living in the same house, or in neighbouring houses, who were isolated?—Yes.

6480. I think two of them got plague?—When they were taken away they were found to have fever. It was the night following the discovery of this first case. We heard of these cases of fever. I saw them and recorded them as extremely suspicious. Colonel Hendley and the Chairman of the Corporation were down there with me; we had a sort of informal consultation, and it was decided that it would be best to remove all the people in that block. We got them all down to Manicktollah the same afternoon.

6481. One of them had all the appearances of pneumonia, had he not?—The boy's was a pneumonic case. At that time his physical signs were more those of bronchitis than pneumonia.

6482. And he died?—Yes; but no *post mortem* examination was made.

6483. The other case was a case of bubonic plague; was it not?—Yes.

6484. Could you give us some details about that?—Parbutty, aged 26, the mother, was stated to have suffered from fever ushered in with shivering for five days. Her temperature on admission was 105° Fah., pulse 110, respiration 30. She had a distinct swelling, the size of a small hen's egg, in the anterior part of the left axilla behind the fold of the pectoral muscles. After two or three days' treatment she began to improve. The swelling suppurated and was opened on the 28th April. She was subsequently discharged convalescent.

6285. In your opinion that was a case of plague?—I have no doubt about it.

6486. It occurred in the same house where the other case occurred?—Within about 15 yards, I suppose, of the first case.

6487. What was the date of this case?—It was discovered the day after the first case died. The first case died on Saturday night. This was discovered on Sunday afternoon.

6488. What date?—April 18th. I had seen plague before that in Bombay, and elsewhere, so that it was not the first time I had seen a suspicious case.

6489. (*Dr. Ruffer.*)—Did you make a bacteriological diagnosis of these two cases?—No.

6490. I think you had a case of plague in an assistant, a dome: I do not know what a dome is?—A dome has to do with dead animals; he helps in the *post mortem* room and stitches up the corpses.

6491. I believe two inoculated themselves at the *post mortem*?—Yes. One I noticed with a rag tied round his finger. I pulled it off and saw a healing cut.

6492. Could you give us some exact details about these two cases?—Of the domes who assisted at the *post mortem* of Issur Chunder Dey and were sent to Manicktollah to be kept under observation, one had a healing wound and the other scratched himself on a point of bone. They were watched with the greatest interest, as it was thought that, if either of them developed plague, it would be a strong confirmation of the diagnosis that had been made in Issur Chunder Dey's case. The one with the healing wound escaped.

6493. He has no symptoms at all?—No. The other Budri dome, aged 54, was found at noon on the 19th, two days after the *post mortem*, to have a temperature of 102°, pulse 105. He complained of frontal headache, pains in the limb and malaise. He was seen by the Medical Inspector in charge of the hospital to have a rigor. At the point of inoculation nothing was observed except the blackness of the skin, caused by nitrate of silver cauterisation. By night his temperature rose to 105·6° Fah. He had a

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dry and coated tongue, a harsh dry skin, congested eyes and a bounding pulse. The bowels were somewhat constipated, etc. He was given a good dose of calomel and soda, which somewhat relieved the general symptoms, but left him much prostrated. On the 21st a swelling was discernible in the bend of the left elbow. The gland could not be distinctly made out owing to surrounding infiltration. The temperature that night went up to 105·4° Fah., after which it declined steadily, and the patient appeared to improve. The arm, however, became swollen and tense from the wrist to the shoulder. The arm was kept in bandages, wet with sulphate of iron, and the general swelling got less. By the 26th the temperature had fallen to 100° Fah., the patient appeared to be progressing favourably and asked for food. On the 28th suppuration having become evident an incision was made, and four ounces of pus were obtained. By the 1st May the temperature was down to normal, the patient took nourishment well and great hopes were entertained of his recovery. But on the 2nd it rose again to 100·2°, pulmonary symptoms set in, and the patient coughed up about an ounce of frothy blood in the evening. He gradually sank, and died on the morning of the 3rd, fourteen days from the commencement of the attack.

6494. Did you make a bacteriological examination of the blood?—No. The corpse was taken away before I could get there. I got down in the morning, and they were just removing the body when I got there: the man had only died during the night. I should very much like to have had *post mortem* cultures in that case, but I was not able to get them at all.

6495. They have not been made?—No.

6496. Have you any personal experience of any other cases of inoculation at *post-mortems*?—Yes. The first were in Madras, Major Giffard and a dome. In September 1897 some racing men had been to the Poona races, and the personal servant of one of them developed plague after their return, and died in the General Hospital.

6497. How long after his return?—He developed plague about two days after he arrived in Madras. The journey from Poona is something under two days.

6498. Roughly speaking, that would be four days?—Yes.

6499. (*Prof. Wright.*)—Is this the case which is reported in Major Green's evidence as having died on October 7th?—I told Captain Green about this case, and he wrote to Major Giffard. It was October the 7th. I was a month out. It is the same case.

6500. (*Dr. Ruffer.*)—We shall have that from Captain Green, so that I need not trouble you with it?—I saw this case all through. Captain Green had it only second-hand from me.

6501. Then we had better have it from you.—This servant died in the General Hospital with all the symptoms of plague. A *post mortem* was made by Major Giffard, assisted by two domes. The *post mortem*, I think, was performed on a Thursday. On M nday, I saw Major Giffard in the Club. He complained of being awfully ill. He said he had had a very heavy day's work, and had fever on him.

6502. Had the symptoms set in on that day?—He felt unwell on a Sunday,—that is, three days. On the Monday he was worse, and I advised him to go straight back to bed, and send for Captain Grant. Captain Grant treated the case. I was watching the case all through, with Captain Grant and Captain Elliot. We considered the question of bacteriological examination; and as a matter of fact, I did prick his finger and examine the blood, partly to see whether there was any malarial parasite there, and partly on the chance of getting a plague microbe from it. The result, however, was negative. He developed axillary buboes. He had had some boils and there was a partly healed scar left from a boil about the wrist, which looked a very likely place for the entry of the infection. His most pronounced symptoms were cerebral excitement and insomnia. He was constipated; his face was flushed, and his eyes suffused. His temperature was not very high,—about 103 or 103·5°: it soon came down to 102, varying a bit. He got over his attack very quickly. He was a very strong man, one of the strongest men I know. He was a particularly healthy man in ordinary times.

6503. Did you make any cultures from the point of inoculation?—No. The other case I did not see till after death: one of the domes who had assisted died. I had not previously heard of his being ill, but as soon as I heard of it I went straight off to his hut and found the body all laid out for burning.

6504. How long after the *post mortem* did you notice symptoms of plague?—I was informed by the relatives that it was three days. I had taken culture tubes, pipettes and a spirit lamp, and a few odds and ends with me on the chance of getting a culture out of him. The people allowed me to remove the clothing that was over him. I found a very marked axillary bubo in this case too, and I made a culture from it, and got the plague bacillus out, so that, although there was no *post mortem* there was a certain bacteriological diagnosis in that case.

6505. Do you know whether Major Giffard had been inoculated?—No, he had not.

6506. After these first cases you got several cases in the city during the month of April. Have you any system of notification of infectious diseases in Calcutta?—Every medical man under the Calcutta Municipal Act is supposed to report any cases of dangerous infectious disease of which he becomes cognizant; but there is no penalty laid down in the Act for not doing so; and it is not very generally complied with.

6507. Do you mean to say the Act is evaded?—Yes.

6508. In the majority of cases, or in many cases?—I should say almost without exception. A few medical men report their cases.

6509. Have you any system of registration of deaths?—Yes. It is mostly done at the burial and burning grounds.

6510. By medical men?—No. We have men at the burial and burning grounds who register all the deaths of the bodies brought there for cremation or burial; so that as a matter of fact we get the numbers tolerably accurately. But as most of these people have never been seen by men with any knowledge of rational medicine, and the registrars themselves have no knowledge of it, we have no exact information.

6511. In fact you take the word of the friends; is that not what it comes to?—Yes.

6512. There is no system of death certificates?—No.

6513. Is there any system of corpse inspection, when there is no certificate or notification from medical men?—No.

6514. None at all?—No. In many cases where we heard of a suspicious case, and went to the house, they allowed us to inspect the body.

6515. But I mean, is there no system of examination of dead bodies as a rule?—No.

6516. Could you give us some evidence as to the wa in which the disease spread through the town of Calcutta?—On the 20th April another case occurred in Kapalitola lane, a Hindu, aged 14, who was taken to the Medical College and died there, and on the following day a Eurasian female, aged 42, was taken there from Kenderdine's lane in the same ward and died. No cases were reported on the 22nd or 23rd. I heard of these cases after they had been taken from the Medical College. I was not able to trace out how the infection had got there.

6517. On the 24th I think seven cases occurred?—Yes.

6518. And you had several cases afterwards. Can you put in a table showing the dates and the number of cases week by week?—Yes. There is a table in my Report* which gives the distribution according to wards as it occurred week by week up to the 31st July. Other figures prepared by me for the purpose of showing the population and death rate of Calcutta and bringing the statistics of general and plague mortality up to the 24th of September are as follows:—

I.—Population of Calcutta by Census of 1891—

(*a*) Under 5 years of age	49,654
(*b*) Over 5 and under 60 years	573,323
(*c*) Over 60 years of age	58,823

II.—Gross mortality for three months preceding the appearance of plague in Calcutta—

(*a*) Under 5 years of age	2,377
(*b*) Over 5 and under 60 years of age . . .	4,865
(*c*) Over 60 years of age	1,873

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* See Appendix No. XX in this Volume.

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III.—(*a*) Weekly deaths from plague in Calcutta according to ages from 14th April to 24th September 1898 :—

Weeks ending—	Deaths from plague under 5 years.	From 5 years and under 60 years.	From 60 years and upwards.	Age unknown.	Total.
1	2	3	4	5	6
From 14th to 16th April 1898	...	3	...	...	3
23rd April	1	2	...	...	3
30th ,, ...	1	18	...	3	22
7th May	...	7	...	...	7
14th ,, ...	...	7	...	1	8
21st ,, ...	...	5	...	...	5
28th ,, ...	...	7	...	...	7
4th June	...	12	1	...	13
11th ,, ...	1	8	...	...	9
18th ,, ...	...	13	2	...	15
25th ,, ...	...	13	1	...	14
2nd July	...	17	...	2	19
9th ,, ...	...	6	4	...	10
16th ,, ...	...	10	1	1	12
23rd ,, ...	...	3	1	...	4
30th ,, ...	...	4	...	...	4
6th August	...	6	...	...	6
13th ,, ...	1	11	...	...	12
20th ,, ...	...	2	...	...	2
27th ,, ...	...	4	...	...	4
3rd September . . .	...	3	...	...	3
10th ,, . . .	...	6	1	...	7
17th ,, . . .	...	1	...	...	1
24th ,, . . .	...	2	...	...	2
Total .	4	170	11	7	192

(*b*) Weekly deaths from all other causes except plague according to age groups from 14th April to 24th September 1898 :—

Weeks ending—	Deaths from all other causes except plague under 5 years.	From 5 years and under 60 years.	From 60 years and upwards.	Total.	Total including plague deaths.
1	2	3	4	5	6
From 14th to 16th April 1898	38	85	20	143	146
23rd April	86	261	59	406	409
30th ,, ...	91	270	71	432	454
7th May	100	210	60	370	377
14th ,, ...	99	193	56	348	356
21st ,, ...	111	220	62	393	398
28th ,, ...	91	174	61	326	333
4th June	82	164	76	322	335
11th ,, ...	71	208	57	338	345
18th ,, ...	57	170	54	281	296
25th ,, ...	82	169	47	298	312
2nd July	61	141	45	247	266
9th ,, ...	71	120	42	233	243
16th ,, ...	87	142	49	273	290
23rd ,, ...	78	161	58	297	301
30th ,, ...	79	186	70	335	339
6th August	75	215	69	359	365
13th ,, ...	107	277	55	439	451
20th ,, ...	78	183	57	318	320
27th ,, ...	89	196	65	350	354
3rd September . . .	87	222	59	368	371
10th ,, . . .	103	182	65	350	357
17th ,, . . .	87	181	55	323	324
24th ,, . . .	91	179	56	326	328

Name of Town affected with plague.	Total population immediately before the outbreak of plague.	Average death-rate from all causes in years when there has been no plague.	Weeks		Total mortality from *all causes*, week by week, during the period of plague.	Total mortality from *plague alone*, week by week, during the period of plague.
			From—	To—		
	2	3	4	5	6	7
Calcutta	681,560 of census of 1891.		1898.	1898.		
		40·9	10th April	16th April	365	3
		38·9	17th ,,	23rd ,,	409	3
		37·8	24th ,,	30th ,,	454	22
		35·0	1st May	7th May	377	7
		32·9	8th ,,	14th ,,	356	8
		30·2	15th ,,	21st ,,	398	5
		29·7	22nd ,,	28th ,,	333	7
		26·1	29th ,,	4th June	335	13
		25·4	5th June	11th ,,	345	9
		24·8	12th ,,	18th ,,	296	15
		28·0	19th ,,	25th ,,	312	14
		27·2	26th ,,	2nd July	266	19
		26·0	3rd July	9th ,,	243	10
		27·4	10th ,,	16th ,,	290	12
		27·7	17th ,,	23rd ,,	301	4
		29·0	24th ,,	20th ,,	339	4
		29·5	31st ,,	6th August	365	6
		28·1	7th August	13th ,,	351	12
		27·7	14th ,,	20th ,,	320	2
		29·6	21st ,,	28th ,,	354	4
		30·8	29th ,,	3rd Sept.	371	3
		30·3	4th Sept.	10th ,,	357	7
		29·5	11th ,,	17th ,,	324	1
		32·6	18th ,,	24th ,,	328	2

6519. (*Mr. Hewett.*)—During your time were there 190 cases?—Yes.

6520. (*Dr. Ruffer.*)—Could you tell us what measures were taken?—The principal measure was to remove the patient to a hospital and then disinfect the house.

6521. How did you perform the disinfection of the house?—In the first case I mostly used a steam-sprayer, the Equifex.

6522. I do not know what that is?—It is on the same principle as a little hand-sprayer, but it is a fair sized boiler mounted on wheels.

6523. Perhaps you will be able to show it to us?—Yes.

6524. Do you know the temperature which you obtained with this steam-sprayer?—It is not high; you could put your hand in the spray. It is to make fine vapour. The effect is not got by heat but by the disinfectant. The steam mixes with the disinfectant.

6525. What is the disinfectant you used?—With that machine we mostly used phenyle: I was not certain at that time whether the receptacle for the disinfectant would stand sublimate.

6526. What strength was the phenyle you used?—That I could not say. We put the phenyle in pure. We poured the phenyle into the receptacle, and it mixed with the steam, and formed a fine spray. It was certainly very strong. It was simply phenyle and steam very finely divided into a spray.

6527. Have you got any bacteriological evidence as to the disinfecting power of this spray?—No.

6528. Afterwards, I think you disinfected with perchloride of mercury?—Yes; the bulk of our disinfection was done with perchloride of mercury. We mostly used a hydronette which threw the disinfectant solution in a strong jet with which we played all over everything. The floor was flooded with this disinfectant and everything was sluiced down.

6529. Did you use an acid solution ?—Yes ; the Local Board formula.

6530. What is that formula ?—Perchloride of mercury half an ounce, acid one ounce, water three gallons.

6531. Hydrochloric acid ?—Yes, hydrochloric acid.

6532. What other measures did you take ?—Lime-washing, and in the case of tiled roofs we took off strips of tiles. I did it practically in the same way as it was done in Bombay.

6533. Did you disinfect the clothes of patients and their friends ?—They were mostly a poor class of patients. We generally burnt the clothes and compensated them. We have got a large Equifex and a portable Lyons disinfecting stove. But when cases occur in poor quarters, and the things are of no value, it is much simpler to burn them on the spot and compensate the people then and there. There is the trouble of doing the things up, carting them away, and disinfecting them, and bringing them back.

6534. Did you segregate the people living in the same house ?—Only voluntarily.

6535. You did not compel them to be segregated ?—No ; I was told at an early date not to compel them.

6536. Did you disinfect the clothes and things of the people who were segregated and isolated ?—Yes.

6537. Did you make a difference between people who had been inoculated, and those who had not been inoculated ?—Yes. People who had been inoculated were practically free of everything. They could travel without being stopped. They could stop in a house if they had got plague, which none of them did, as a matter of fact.

6538. But did you turn them out of their houses ?—We never had occasion to. We should not have done it in any case except for the purpose of disinfecting the house very temporarily. But it was not necessary, because no cases occurred in a house where there were inoculated people.

6539. Did you inoculate any of the friends of the people who died ?—In some cases, not many. At first I thought it better not to push that upon them because inoculation was rather ticklish work to institute in a place like Calcutta. If any inoculated person had died when we were commencing it, it might have knocked the whole thing, and prevented us ever instituting it. So that I did not press it upon the people at first. I feared that some of the people might already have contracted plague and that if the disease developed in them after inoculation it would be attributed to it and no more would be inoculated.

6540. A great many people left the town, I believe ?—Yes.

6541. How may do you think left the town ?—I think roughly speaking from about 150,000 to 200,000 people must have left the town.

6542. Out of a population of about 700,000 ?—Yes.

6543. Why did the people leave the town ?—Through panic. Their constitution is timid. It takes very little to cause a panic amongst them.

6544. What were they afraid of : the plague ?—I think it was more segregation and that kind of thing. And I think unscrupulous people did a great deal in fomenting panic, and painting these things in the worst light, and so frightening them for their own purposes.

6545. Do you think they feared segregation or disinfection ?—They do not much object to disinfection as a rule.

6546. Did you have many cases of plague in evacuation camps ?—After the first case or two we never had any people in segregation camps.

6547. I believe that the general mortality during the plague epidemic in Calcutta was much lower than usual ?—Yes, calculated on the population of 1891.

6548. What is the explanation of that ?—The principal explanation is that about a quarter of the population were away a great part of the time ; so that if you calculate on three-fourths of the population, the death-rate becomes just about normal. I tried that week by week as we went on.

6549. Is it not a fact that a great many children left the city ?—That especially would make the mortality rather lower than the numbers going away.

6550. I believe the mortality in the Plague Hospitals was very high ?—There was a case mortality of about 80.

6551. Do you think many people were taken to the hospital in a dying condition ?—Yes, undoubtedly.

6552. Did you make any observations on the presence of micro-organisms in the blood of those patients ?—No.

6553. I believe you have reason to suppose that a great many cases of plague were hidden ?—I have no direct evidence upon that point : I have only a general suspicion that a number of cases were hidden. I have no evidence to produce upon that. The unequal number of males and females, and things like that gave me an idea. Of course there are always rumours flying about at these times ; but how much credence to give to them we do not know.

6554. I believe the mortality amongst Christians was rather high ?—Yes. That was another point. The Christians more readily send their people to the hospitals. They are a hospital-using class. They showed a high mortality. But on the other hand in the part of the town where most of the plague cases occurred, there are a large number of poor Christians, Eurasians and native Christians, and so on, —a very poor and dirty class, a very poverty-stricken class indeed.

6555. The mortality among the Hindus and Muhammadans appears to be much lower. In your report* you give the attacks and deaths per thousand amongst the Christians as 2·8 and 1·7 ; Hindus 0·75, and 0·6 ; Muhammadans 0·89 and 0·76. Would not that suggest that many cases were hidden among the Hindus and Muhammadans ?—I drew that inference myself.

6556. I believe you have done a great many inoculations ?—Nearly 1,500.

6557. Could you give us the general results of the inoculations ?—I wrote a few short remarks in reply to some questions put to me about inoculation. They are as follows :—

"I was in charge of anti-plague inoculations in Calcutta, and beg to furnish the following information, as required by the Commission :—

"The following table shows the caste and sex of the inoculated :—

Caste.	Male.	Female.	Total.
Hindus	606	283	889
Muhammadans . .	798	435	1,233
Europeans . . .	84	76	160
Other nations . . .	143	65	208
Total .	1,631	859	2,490

"*Social position of the inoculated.*—The Europeans inoculated, almost without exception, occupied a good social position. A large proportion of the Hindus belonged to the Brahmo Samaj, and were well-to-do people. All classes of Muhammadans were represented about proportionally, some of the upper class setting the example, which was followed by the middle and lower classes. As no attacks occurred amongst the inoculated, no comparison can be made. Moreover, the number of inoculated is too small in proportion to the whole population for any inference to be drawn as to the protection obtained from inoculation, as, if both classes had suffered equally, only about one attack would have occurred amongst the inoculated.

"*The gross mortality from plague, in each of the above three categories of persons, among the inoculated and non-inoculated, week by week, after the introduction of inoculation.*—As no attacks occurred among the inoculated no comparison is possible.

"*The gross mortality from all other causes among inoculated and non-inoculated persons.*—I only know of one death amongst the inoculated, though others may have occurred. This was due to abscess of the liver, which occurred some months after inoculation.

(*a*) *Possible evil effects* (*if any*) *of inoculation.*—I did not observe any lasting evil effects.

(*b*) *Clinical aspects and especially the date of onset of plague among the inoculated.*—I have no experience of attacks amongst inoculated human beings. My animal experiments were not sufficient to warrant any reliable conclusions. In Guinea pigs I found that only very large doses, thirty times or more, weight for weight, than would be given to human beings, afforded

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* See Appendix No. XX in this Volume.

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protection; but I do not consider that this is any test of its protective influence on man, as in my cases even such large doses did not produce any appreciable effect on the temperature or local reaction in Rhesus monkeys or Guinea pigs.

(*c*) *Possibility of several attacks of plague occurring in the same person and the duration of immunity produced by inoculation.*—I was not permitted to continue my animal experiments long enough to test the duration of immunity. I have, however, two Rhesus monkeys that were inoculated four months ago, and which might now be tested with two controls if Government permits it."

6558. When you performed inoculations you took care to test the supply sent to Calcutta?—From time to time.

6559. By bacteriological examination?—Yes.

6560. Could you tell us exactly how you tested it, the method you employed?—By cultivation in agar and fresh broth.

6561. How much of the prophylactic did you put into agar or fresh broth?—I think about ¼ c. c., only a small quantity: a few drops spread over the surface.

6562. How many bottles have you examined altogether?—Altogether I suppose I have done about a dozen such examinations.

6563. Have you found any living organisms in Haffkine's fluid?—No.

6564. Nothing?—No.

6565. Have you examined it under the microscope?—Yes.

6566. Have you found appearances which would lead you to think that the fluid was putrid, and contained other micro-organisms?—No.

6567. In fact all the samples you examined were sterile?—Yes.

6668. How many bottles of prophylactic did you use for your inoculations?—About 400.

6569. (*The President.*)—Were these 400 bottles from the same brew or from different brews?—Different brews.

6570. (*Mr. Hewett.*)—The total number of inoculations here was comparatively small, was it not?—Yes.

6571. The number did not go anyway towards protecting the population?—Not the slightest. It was making a start to get it established, so that we could work it. It always takes some time for people to get accustomed to any new measure, and get over the fear of it.

6572. Two thousand five hundred inoculations only were done, I believe?—Two thousand four hundred and ninety.

6573. You made some remark about the large proportion of male attacks to female attacks; I suppose there are twice as many males in Calcutta as there are females?—Yes; there are many more males than females in Calcutta.

6574. Can you give us the figures of the male attacks and the female attacks?—I have them down here. I worked them out, showing the proportion of the population and the proportion of the attacks. You will find it on page 21 of my Report.*

6575. The actual total was 152?—The number of male attacks was 152 and female 38, giving a proportion of 400 to 100. This large excess of male over female deaths occurred amongst the Hindus and Muhammadans. In the Hindu population there are 174 males to every 100 females, but the plague attacks were in the proportion of 483 to 100 or 2·7 times more numerous among men than among women.

6576. Do you think that those facts point to a concealment of plague cases among females?—Yes. Allowing for the larger proportion of females than males having left the town and so upsetting the original balance of 174 males to every 100 females, I think even then the male attacks are more than they ought to be in proportion to the female. I do not think that in any part of India one would hear of the attacks amongst the females of a certain age, whatever measures were taken.

6577. You state that groundless reports reached you about inoculated persons having died: you say, "None of them had more than transient fever and local reaction": did you keep any record of the people you inoculated in the Brahmo-Samaj and Armenian College?—I have no written record; but I went to see most of the cases myself after I had inoculated. If I did not go myself I sent a Medical subordinate.

6578. I thought, perhaps, that you might have kept some record of these particular cases to show what happened to them?—There was nothing worth recording. I was very busy at the time, and had all sorts of other business to do.

6579. Did you do all your inoculations with 2½ c. c. of the fluid?—They varied in proportion to the strength of the brew sent. In most of them it was double that quantity; in a few, I think three times that quantity.

6580. You did not evacuate the houses adjoining the houses in which cases of plague were found?—No.

6581. Did you make any sort of enquiry to find out when the plague went from one house to another, and whether it went by means of people going to visit their neighbours, or whether it was moved about by rats in any way; have you any facts which will help us in coming to a conclusion upon that?—My best facts I give in an Appendix to the "Report on Plague in Calcutta" which I prepared.* They occurred after I handed over the charge to Major Bannerman. He was in charge then. We were working very much in consort. There is a table showing how it was taken from one part to another through evacuating certain huts without taking any precautionary measures.

6582. This report was prepared by you and Major Bannerman?—It was really written for the *Indian Medical Gazette.* It was not an official report. We wrote it as we thought it had a certain interest for the profession in India who might have to deal with similar circumstances.

6583. When did the first case of plague occur at Fairlie Place?—On the 25th April.

6584. The reason I ask is because I think this is the very spot in which you had an outbreak among the rats?—Yes.

6585. Was it in these godowns at Fairlie Place that the dead rats were discovered?—The other side of Fairlie Place. It would be about 50 yards away.

6586. Not more than that?—Perhaps it would be about 100 yards away.

6587. (*Mr Cumine.*)—Did I understand you to say that all the sick people were removed to the hospitals?—I did not say they all were; not all of them.

6588. As many as you could find?—In a few cases they had good airy upstairs accommodation which was fairly isolated. In instances of that sort two or three cases were allowed to remain, and the houses were licensed as family hospitals.

6589. Did you find any bad effects resulting from that?—No.

6590. What did you do with the other people of the house where the patient was allowed to remain in the house; were all the other people in that house also allowed to remain in?—Not in the room. In a case of that sort we treated it on its merits. It might be that the whole of the upstairs portion, or a part of it, was tolerably well isolated. That was kept entirely apart for the patient and one or two attendants. We did the best we could. Of course I cannot give very definite evidence as to how far our orders were carried out. I think, on the whole, those cases were fairly isolated. We did not allow it with people who would not do something for themselves. Poor people, who had no decent accommodation, were taken to the hospital.

6591. When a patient was taken to the hospital, what was done with the other people in the house?—The people in the room had to leave that room, and it was thoroughly disinfected. A house in Calcutta is a very various sort of thing.

6592. Take the room first.—The room was generally kept empty for a week or more afterwards.

659. Where were the people put: were they allowed to go anywhere they liked?—Yes.

6594. Was any eye kept upon them in the place they went o, to see whether they took plague there?—Generally speaking it was found impossible to follow them up.

6595. Did they generally return to that room again in a week or ten days?—No; it was often a great deal longer before they came back.

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6596. Did you find when they did come back that they got plague again in that disinfected room?—No.

6597. Did you hear of plague cases generally before death or only after death?—More often after, or very shortly before death.

6598. Was the information generally given to you privately or by the friends of the patients?—More often, I think, by the enemies of the patient.

6599. Did you find that plague-stricken people were carried from one house to another so as to conceal their whereabouts?—Instances occurred of that being done, undoubtedly.

6600. Did you find that those houses to which they were secretly conveyed were infected by the sick person?—I have no evidence upon that point. I do not remember a case in which I was able to trace out infection being carried in that way.

6601. What, in your opinion, was the reason of plague ceasing: why did it stop?—I can only give theoretical reasons. There may be bacilli here which secrete a toxin which inhibits the growth of the plague bacillus outside the body, or that use up the nutriment that it would live on. My own private opinion is that what we did did not affect it in any appreciable degree.

6602. Did you find that the force of the poison got weaker and weaker as the plague disappeared?—No. Some of the most virulent cases I saw were those mentioned in the Appendix,* which were quite at the end. Besides that, since then the cases that have occurred have been the very worst pneumonic cases, some of them: so that there is no evidence of the virus having been attenuated.

6603. (*Prof. Wright.*)—I understand that the ordinary medical practitioners in Calcutta are supposed to notify cases to you. Do the hospital officials report cases of plague to you?—Under the ordinary Municipal law, I believe doctors are required to report cases.

6604. Are the hospitals not compelled to report cases to you?—I do not think they are here.

6605. If you had a system of corpse inspection, would it help you much in determining whether there was plague or not in Calcutta?—I think it would.

6606. Do you think natives would object very much to corpse inspection?—I think it depends very much upon how it is done. With Brahman doctors, I think any objection on the part of a Hindu would easily be got over as far as the males are concerned. But as far as the females are concerned I think it would be much better left alone. It would cause so much trouble. After all, if we inspected most of the males it would give us a very good idea.

6607. Would there be any objection to women doctors examining the female patients?—I do not think they would like them to be examined even by women doctors.

6608. In the first case of plague you reported, were you able to find out what was the source of infection?—No, I could not. I made every enquiry I could think of, but I could not get on the trail of it at all.

6609. You gave us some details with regard to two domes; one had a wound and the other scratched himself. You stated that you cauterised the man who scratched himself without any good result; you cauterised him with nitrate of silver?—Yes.

6610. Did you cauterise deeply?—Yes.

6611. Soon after?—On the spot.

6612. What about the "healing wound": was that cauterised?—I am nearly sure it was; it must have been.

6613. Do you remember in those Madras cases whether cauterisation was adopted?—No, I was not present at the time; I do not know at all.

6614. Have you any experience or knowledge about *pestis ambulans*: have you seen any mild cases which you think may have been plague?—That would be a very difficult question here, because, I believe, there is a form of fever which occurs in Calcutta that is accompanied by glandular enlargement of one or more glands, so that it would be a very difficult matter, without bacteriological evidence, to decide whether a case was one of mild Bengal fever, if you may call it so, or a case of *pestis ambulans.*

6615. With regard to disinfection, you said you had never seen a case of plague recurring in a disinfected house, is that so?—To the best of my recollection that is so.

6616. What about taking off tiles; do you think yourself that is a useful method?—I think it is, in a dark damp sort of place, if it is done sufficiently freely; but I do not think it is of any use taking off a few tiles. If about half the roof is taken off, I think it is a good measure.

6617. Are the tiles taken down, or heaped on the top?—Heaped on the top.

6618. Are the battens taken down?—No.

6619. With regard to the question of the sterility of the vaccine, in testing the sterility of the vaccine did you dilute it first before inoculating it on to agar?—No.

6620. Do you remember whether the vaccine which you tested was fresh, or whether it had been kept for some time before you tested it?—In most instances it was soon after we got it; it was tolerably fresh.

6621. Do you think the method of putting up the vaccine which is adopted by M. Haffkine is convenient or inconvenient?—I think it is very inconvenient. There is a lot of bother opening the bottles if you have to inoculate a great many people; and the bottles are awkward to put a syringe into. You want a number of asistants to carry on inoculations.

6622. Have you seen any cases in which you thought the reaction after vaccination was too slight?—Yes.

6623. Have you seen cases in which there was practically no reaction?—I have seen some cases.

6624. Have you seen any cases in which the reaction appeared to be excessive?—Yes, rather excessive.

6625. Did you vaccinate the patients twice, or only once?—Most of the patients were only vaccinated once; but some of them were vaccinated twice.

6626. Have you observed that the results from the second vaccination are slighter than those from the first?—Not in my own case, certainly; I think they were more severe. The vaccinations were within two or three days of each other, so that it might have cumulative. It might have been different if I had waited longer.

6627. Have you made any experiments upon animals to see whether the doses prescribed have always the same effect upon the animals?—No. The animals I have inoculated do not react like men and I believe such a test would have little or no value.

6628. (*The President.*)—I think you said there is no penalty paid for failure to notify infectious disease?—There may be a general penalty which applies to any section of the Act; but as far as I remember there is no penalty under that particular section.

6629. Is there any reward or fee paid for such notification?—No.

6630. It is not unusual in many cases to pay a fee?—I know that.

6631. I suppose there is no system of registration of medical practitioners at all here?—No.

6632. Do you think that is impossible?—I think it would be a very good thing to have such a system here.

6633. Do you think it is practicable?—I do not think it would be possible to enforce if very strictly at first; I think it would be a good thing to have, and then gradually to make it more stringent.

6634. I suppose one of your great difficulties has always been the early notification of these plague cases?—Yes.

6635. Is it probable that if you had a registered profession, with good qualifications, you would get this notification earlier?—I doubt it; because the class of medical practitioners here is very much lower than what you are accustomed to find at Home. Half the people employ absolute quacks. We call them kabiraj, vaids, hakims, and all sorts of names; but they have no knowledge of rational medicine at all. For instance, a man will have two medicines, in some cases he will give one medicine, and in some cases the other medicine, and in a very bad case he will give both medicines, and that sort of thing. You cannot expect a man of that sort really to have the knowledge to notify a disease. I think it would be better to make the people themselves notify the well-known infectious diseases, like cholera and small-pox, which they are capable of recognising as well as the average so-called medical men here.

6636. You think that at the present moment medical practice is so largely in the hands of an uneducated class that it

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could not be done?—And the people themselves, taken as a mass, cannot appreciate rational medicine.

6637. I think you have performed, or there have been performed here, 2,490 inoculations?—Yes.

6638. Immediately before the plague what do you estimate the population to be?—Nearly 700,000.

6639. Six hundred eighty-one thousand and three hundred?—It worked out that if the same number of deaths had occurred amongst the inoculated as the uninoculated, there ought to have been just one death amongst my 2,490 inoculated people, so that for the purpose of comparison it is absolutely valueless. The chances of one death occurring are about equally balanced.

6640. When did you commence inoculation?—The day the disease was notified in the town: I think it was Saturday, 30th April.

6641. When had you completed the 2,490 inoculations?—Up to the 22nd of July.

6642. From the 30th of April to the 22nd of July?—Yes; the numbers are given week by week on page 26 of my Report.*

6643. What inducements were offered to the people for being inoculated?—In many cases I went to their houses. In the case of Muhammadans, some of the leaders of the Muhammadan population here took it up and were inoculated before a lot of the people. They arranged for a lot of the people living round to come to a large room in their house or verandah or something of that sort, or sometimes they would put up a sort of a pandal as it is called, in the middle of one of these hutting grounds. I used to go down there, and nearly all the people of the bustee would come and be inoculated.

6644. I suppose any one who wished could be inoculated?—Yes, I thought it would be better to go about and let them make their own arrangements like that than to have a fixed place which they would probably not go to, though I did inoculate at my office two afternoons a week.

6645. Were there any other inoculation stations except at your own office?—Dr. Traill Christie was the only inoculator up to the end of my having the plague work. It was thought better, on account of the trouble in the town, that no one else should inoculate, because then there could be no mistake about who was an inoculator and who was not an inoculator. Of course, they made things very unpleasant for people who were supposed to be inoculators.

6646. Do you think if you had a larger number of stations you would have succeeded in having a larger number of inoculations?—I do not think it would have made any appreciable difference.

6647. You did not inoculate a large number out of the total population in that time?—No.

6648. It seems to have proceeded slowly?—From conversations I had with different communities, and that sort of thing, I understood from them that they had got over their prejudices to a great extent. Everybody was telling them that it was not plague and that there was nothing to be afraid of, but that they would all come forward with a rush as soon as the leaders gave the signal that it was time to be inoculated. Their chief objection was that they would have to be inoculated again so soon.

6649. How soon was that?—They had an idea it would not last three months: that went all over the town.

6650. Did the leaders come forward?—Only in the Muhammadan community. A few of the better class people of all communities came forward, but it did not get really taken up. The plague did not get quite bad enough. I think inoculation might have been boomed here, and at least half the population, if not more, inoculated, if the plague had gone on and spread sufficiently to exercise a little influence upon their minds in the direction of being inoculated.

6651. In a large city like this it would therefore be rather difficult to have a large number of people inoculated before the plague became serious?—It is much more difficult to get them to be inoculated before plague becomes serious. The authorities did not like the idea of my lecturing about it, or going about telling the people of it. I think they thought there were political reasons why it would be better not to advertise it too much.

6652. You are Health Officer for the whole of Calcutta, I suppose?—Yes, all the Corporation. That does not include the Fort.

6653. Whom have you to assist you in your duties as Health Officer?—I have a native Assistant Health Officer, and an East Indian Superintendent of Conservancy, and a subordinate staff, mostly natives, some native Medical Inspectors, and then Superintendents of Conservancy, Sanitary Inspectors, and so on.

6654. These are Nuisance Inspectors, I suppose?—Yes.

6655. Who would the medically educated portion of your staff consist of, yourself and who else?—Myself, the Assistant Health Officer, and the Chief Superintendent of Conservancy; then we might put in Food Inspectors, and Analysts, and people of that sort. What is more wanted than anything else is two or three really good English Sanitary Inspectors to put in as Superintendents of Conservancy, in order to get the Sanitary Inspectors into a good way of doing their work.

6656. Active sanitary improvements have been going on lately in Calcutta?—We have made some improvements.

6657. Actively?—Do you mean in consequence of the plague?

6658. Whether in consequence of plague or not, there has been a good deal of sanitary improvement going on recently in Calcutta, has there not?—I cannot judge how much greater activity has been shown. I have only been here this year.

6659. Have you noticed that the incidence of plague has been in the most insanitary districts of Calcutta?—No. Some of the cases were in very good houses, in decent sanitary streets; certainly a number of cases were in a poorer class of houses.

6660. You cannot express an opinion about that?—I think it was probably more the people. I think it is very much a matter of where the infection gets carried; and I have no doubt it has a greater chance of getting carried in poorer localities where people mix about in closer contact, and generally crowded together; but I do not think there is sufficient evidence that the contagium morbi prefers foul places to healthy places.

6661. You have had very few cases in Calcutta?—We have had very little experience. There are not enough cases to generalize things of that sort.

6662. (*Dr. Ruffer.*)—You said in your answer to Professor Wright that occasionally the re-action was rather excessive in the inoculated?—Yes.

6663. What do you mean exactly by that: do you mean the temperature went up too high?—I do not think I ever got a temperature of over 105, if quite as much. I think about 104·5 or 105 was about the highest temperature. One lady I did not see until about a week after her inoculation. She told me that every gland in her body had been enlarged, and that she had been very ill for the week. The glands had gone down, and she looked better; but she seemed rather pulled down by it.

6664. Did you get any abscesses?—Not one.

6665. You said something about having produced immunity in animals?—I did some experiments in that direction but I never completed them. I got very little way in my experiments.

6666. You have no facts that you would like to place on record now?—Only that the dose required for the animals I experimented with is simply enormous to produce any effect at all: I have used thirty or forty times the dose, weight for weight, I should use for a man, and produced no appreciable effect upon temperature, and no visible local reaction.

6667. Using Haffkine's fluid?—Yes, with Rhesus monkeys and Guinea pigs.

6668. Did you try and immunise animals with living cultures?—No, I was trying to obtain a minimum lethal dose with a view to work of that kind; but, as I said, I was stopped before I really had done anything. I was very near to it. I did inoculate some protected animals which recovered and some unprotected ones with the same dose that died.

6669. Is there any inoculation going on now in the town?—Not that I know of. It is not under me now.

6670. Do you know why the people got inoculated: did they get inoculated for fear of plague, or to get some special favours?—I think both the reasons operated. I think to get immunity from plague measures had more influence with them, than the immunity from plague.

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* See Appendix No. XX in this Volume.

6671. (*Prof. Wright.*)—Do you direct any operations against plague: what are your functions when an epidemic breaks out?—My functions are to advise the Chairman.

6672. Are you responsible for disinfection?—Not now. I was, but now I am not. That is a matter entirely for the Plague Department now.

6673. Then as soon as plague broke out the administration of plague was taken out of your hands and put into the hands of a Plague Commissioner?—No. The plague broke out in April; I did everything until about the end of July. Since then I have had nothing to do with it.

6674. Into whose hands was it passed over?—To Major Bannerman's hands until he was re-called to Madras, then Major Green was appointed.

6675. Beyond studying the distribution of plague in the town you have nothing to do with it?—No.

6676. Have you to collect statistics of where plague occurs?—No.

6677. (*Mr. Hewett.*)—I understood you to say that the recorded mortality during the hot weather of 1898 was less than the average recorded mortality?—Yes.

6678. Was it larger or less prior to this outbreak of plague, *i.e.*, before April last?—It has been a healthy year; apart from plague it has been a distinctly healthy year.

6679. Was it lower than usual?—Yes, there have been some bad years before this, but this year, it was much better.

6680. Is it higher or lower than usual now?—Lower.

Dr. J. Nield Cook.

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6681. Is it higher or lower than usual in the neighbourhood of Calcutta and the districts outside?—I have not got the figures for this year for the neighbourhood outside. I did see something about that. Major Green worked that out the other day. I think he could give you some information upon that point. I know he was asked to report about the mortality and the registration; and he took some of the towns near.

6682. Do I understand you to say that the people would not object to the inspection of male corpses?—I do not think Hindus would object, if it was done by Brahmans; but it is rather difficult to get Brahman doctors here?

6683. What about the Muhammadans?—The Muhammadans, if the doctors were a good class and the right sect, would not object to it so far as their males were concerned.

6684. Do you think that there are difficulties in the way?—There are very appreciable difficulties. It would want to be very delicately handled.

6685. Do you think that there might be at any moment difficulties about it?—I have talked to a good many natives about it, and some thought it could be done. They rather pressed it upon us as a measure.

6686. Would corpse inspection help you in the case of a pneumonic form of plague?—I doubt it.

6687. You would find it help in the case of buboes, in the summary examination you would make, but would it be of any use in the case of pneumonic plague?—It might be of use. There might be dribbling saliva.

6688. Would the result of inspection in such cases be uncertain?—I should think it would be uncertain.

(Witness withdrew.)

MAJOR DYSON, I.M.S., called and examined.

6689. (*The President.*)—You are in the Indian Medical Service?—Yes.

6690. And you are Sanitary Commissioner of Bengal?—Yes.

6691. Since what date?—Since August 1895.

6692. That is to say, before the plague?—Yes.

6693. In 1896, I think you had some scare with regard to plague?—Yes.

6694. What was that?—It was that a certain number of people had been found with enlarged glands and in their blood, often from the finger, the bacilli of plague were found; but only one case died of all of them, and that man had other symptoms which can account for his death on other grounds.

6695. How many cases were there altogether?—Eleven; and in five bacilli were found in the blood by Dr. Simpson, Lieutenant-Colonel Cobb, and Surgeon-Lieutenant-Colonel Tomes.

6696. And was the observation confirmed?—No; these germs were examined by Surgeon-Lieutenant-Colonel Cunningham and he found they were mostly cocci and staphylococci. In the first case he considered they were not the real germs, and the germs which were found were pure contaminations.

6697. They were probably accidental?—Yes.

6698. The evidence was against this case being a case of plague?—Very much against it.

6699. When did plague actually occur here?—In April of this year.

6700. Have you made a careful inquiry into this first case?—I saw the case myself.

6701. You have done all you could to discover how it originated in Calcutta?—Yes, but I am sorry I could not get that confirmed. A man was said to have come from Bombay—this is before the first case which was reported—and he went to No. 10, Kenderdine's Lane. He is said to have had fever and bubo and was taken to the Medical College, and was very delirious there. His friends were not satisfied with the treatment and brought him back to Kenderdine's Lane, and he died there. Opposite his window there was a lady living, and his body was under her window that night. She subsequently was one of those cases that went to the Medical College. I went to Kenderdine's Lane and tried to get evidence about the man, but every one denied him; they would not own him.

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6702. Then you have not been able to trace the origin?—No, it is not complete.

6703. When was it the city was declared to be infected with plague?—I cannot remember exactly.

6704. You took various precautions; what was the nature of the action which you adopted?—We had all the sick people, if possible, removed to the hospital, and only in one case did we practically segregate the people. That was in the first case, when we took them to the Manicktolla Hospital; that was the only segregation done.

6705. The friends and relations?—Yes, they were practically attending the patient in the hospital.

6706. In every instance where plague has occurred, what has been your action?—The first thing is to get them out of the house and segregate them if possible, but at all events to disinfect the room where the patient had been. I always like to see the people themselves segregate the sick, as they have done near Barisal.

6707. To what extent did you succeed in segregating the friends as well as the patients?—We only had these cases in Barisal. They were in the villages, and all the huts were standing apart, so that one set of people could easily segregate the others.

6708. What was your action here?—We did no segregating at all.

6709. You simply disinfected?—That is all.

6710. Do you know of any instance in which the plague extended from one house to another?—I did not have much to do personally with plague after the first few cases. I am not the Health Officer of Calcutta; I am only called in sometimes by the Plague Commissioner for a special inquiry. I think the Corporation have their own Medical Officer.

6711. Among the measures you adopted did you adopt the detention of passengers by rail?—Yes.

6712. Can you tell me to what extent that has been carried out?—We have three camps, at Khana Junction, Damukhdia Ghaut, and Kattahar Junction. Then recently we stopped those and put down camps at Chausa, Chakardharpur, Mariwa, and Khurda Road.

6713. What is the total number of the people inspected?—1,826,656.

6714. And the number detained?—41,854.

6715. Out of those how many cases turned out to be plague?—There were six cases which I think were real

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plague; but for want of bacteriological evidence we did not decide they were plague. Cultures were sent, but in one case the cultures gave a negative result, and in the other cases the media were too dry.

6716. Did you see these cases?—I saw the first which came from the Hoshiarpur District. I have seen plague before last year in Bombay. I saw this man and I thought he certainly had plague from the clinical features. The case of the compounder is an interesting one, because they did not realise at the time that the man had probably died of plague. He was attending a man who came from Pathuria Ghaut, and that started the epidemic of pneumonic plague in Barisal. This man came up to Chausa, and was taken out of the train for pneumonia. He died, and three days afterwards the compounder was taken ill and died also of pneumonia. He was in good health before. I believe these were really pneumonic cases.

6717. Three days after the first man died the compounder was attacked?—Yes.

6718. Do you know how long the compounder had been in attendance?—He was admitted to the hospital on 30th August 1898 and died on 6th September 1898.

6719. You think this compounder acquired the disease from the patient?—I think so, undoubtedly.

6720. And the incubation stage will therefore be?—Just over three days.

6721. I do not know whether you wish to give us any evidence regarding the first cases of plague here?—I think Dr. Cook has given you all the cases. I saw the first cases.

6722. You put in* a "Note on the cases reported as Plague in Calcutta", and "Reports on suspected cases of Plague"?—Yes.

6723. In the "Note on the cases reported as plague in Calcutta" it is stated: "In the case of Bepin Behari Dutt, whose clinical symptoms we have already discussed, a specimen of blood and some blood-cultures were sent to Dr. Cunningham, together with portions of a rat into which two cubic centimetres of a culture of blood had been injected, causing its death in 31 hours. The specimen of blood and the cultures showed, as has been mentioned above, unequivocal evidence of contamination by the presence of large bacilli, probably of a putrefactive character, which must have gained access to the preparation from outside." How long after death was the blood examined?—I am not responsible for that; the bacteriological part was done entirely by Dr. Cunningham.

6724. In the "Reports on suspected cases of plague", in a letter from Dr. Simpson, the Health Officer, Calcutta, to the President, Medical Board, dated 5th November 1896, there is given the history of the case of Bepin Behari Dutt. On reading the clincal symptoms of this case does it not strike you it might have been a case of plague?—By merely reading the clinical symptoms it might, but I do not think the subsequent enquiry led to that conclusion.

6725. Why do you think it shows it was not plague?—We have first the history. He was a sugar-boiler and burnt his toe and had an enlarged gland as a consequence, and was very lame.

6726. He did not burn it severely?—It made him lame for the time being.

6727. I see you say "the patient is said to have scalded his toe more than a fortnight ago, but we found no marks on the foot?"—No, but he had been going lame.

6728. I draw your attention to the clinical symptoms: "The tongue was furred in the centre, and red at the tip and edges. Pulse was 160 and respirations 32 per minute. The body, especially the head, face, and legs, was covered with a profuse perspiration. Petechiæ in large numbers were to be seen on the chest and abdomen, and a few on the back, arms, and legs. They varied in size from one-tenth to one-fourth inch in diameter and did not disappear on pressure. Both the inguinal and femoral chains of lymphatic glands on the right groin were enlarged. Two of the former and three of the latter were felt to be swollen. In the inguinal region the largest was the size of a boy's marble and in the femoral that of an almond. Blood was taken from the enlarged femoral gland and from the medium basilic vein. Microscopic examination showed diplo-bacteria." Is not that more or less typical of a case of plague?—As written there, it sounds very like it, I admit; but with regard to the petechiæ I have evidence that the man who attended him and who noticed these marks himself was informed that they were mosquito bites. He had double orchitis severely which might account for the enlarged gland. It was not considered very dangerous by any of the physicians who attended him.

6729. Is it entered in your report that he had double orchitis?—Yes, you will find it in the particulars obtained from Behari Lal Das who had attended Bepin Behari Dutt.

6730. Did the patient die?—Yes; I never saw it personally.

6731. How do you account for the death? The double orchitis would not kill him?—But he had acute fever; that might have killed him.

6732. He had all the symptoms of plague *plus* double orchitis?—Yes.

6733. Do you think it might have been a case of plague?—I think it is just barely possible. Personally I do not believe it was.

6734. (*Prof. Wright.*)—You went down to inspect this case; did you enquire into the clinical history or prepare specimens?—I did the clinical history only.

6735. You did not prepare specimens?—No.

6736. Who did them?—Dr. Cunningham himself.

6737. What about ambulatory plague; has it come under your own personal experience?—Do you mean in this recent epidemic?

6738. You make a statement that you are aware that there is a form of ambulatory plague?—It is merely from reading.

6739. You have not seen the cases?—No.

6740. (*Mr. Hewett.*) You have only had 230 cases of plague in Calcutta, and 14 in Barisal?—Fifteen, I think.

6741. The infection of which was directly traced to Calcutta?—Yes.

6742. It does not exist anywhere else in the country so far as you know?—No.

6743. Has this been a generally healthy year?—Extremely healthy.

6744. Where, in Calcutta or in the districts?—All round the districts and everywhere.

6745. (*Prof. Wright.*)—Do you control plague operations?—Outside Calcutta, and being on the Plague Commission I am sometimes consulted about Calcutta.

6746. But as a Sanitary Commissioner you have no dealings with Calcutta itself?—No, it is outside my province.

6747. Inside Calcutta you are only a member of the Plague Commission; you are not Sanitary Commissioner?—No, only a member of the Plague Commission.

6748. When did you abdicate as Sanitary Commissioner and come on again as a member of the Plague Commission?—I have never abdicated the Sanitary Commissionership.

6749. But it was taken out of your hands and came into your hands again as a member of the Plague Commission?—No; I have never actually had it given into my hands or taken away.

6750. Who has to deal with the epidemic; you said it existed in your hands as Sanitary Commissioner outside Calcutta?—All the plague precautions I did in counsel with Mr. Risley, Municipal Secretary to Government.

6751. (*Mr. Hewett.*)—As Sanitary Commissioner you have no executive authority?—No.

6752. You are an adviser?—Yes.

6753. (*The President.*)—Who has this executive authority?—The District Officers.

(Witness withdrew.)

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* See Appendix No. XXI in this Volume

Major Green, I.M.S., called and examined.

Major Green.

29th Dec. 1898.

6754. (*The President.*)—You are Special Health Officer to the Corporation of Calcutta?—Yes.

6755. And have had executive charge of plague arrangements, I think?—Yes, since the 13th September last.

6756. Will you give us some particulars as to the staff which has been employed on plague duty and the special plague arrangements?—Major W. B. Bannerman, I.M.S., of the Madras Service, was appointed Special Health Officer in charge of the plague operations on July 22nd, taking over from Dr. Cook, the Health Officer. Major Bannerman continued in charge until August 27th, when he was recalled by the Madras Government for plague duty in Madras. Dr. Pettifer was in charge until September 13th, when he was relieved by me, and I continued in charge until Calcutta was declared free from plague on October 10th, in Notification No. 6026 of the Bengal Government, Municipal Department. Calcutta was at this time divided into six districts with as many district officers. In charge of each district was a Medical Officer with a Medical Inspector under him, as detailed in the following table:—

Medical Officer.	District No.	Wards in District.	Office.	Medical Inspector.
Dr. Justice . .	I North .	1, 2, and 3	65, Beadon Street.	Dr. Bezbaroa.
" Nariman . . .	I South .	4, 5, and 6	Do . .	" G. C. Dey.
" Mackenzie .	II " .	7, 8, 9, 10, and 11.	Town Hall	" Ayatulla.
" Clemow . .	III " .	12, 13, 14, 15, 16, 17 & 19.	Do . .	" Syed Mahomed Ali.
" Laing . .	IV West .	18, 23, 24 & 25.	5, Budge-Budge Road.	" P. N. Pal.
" Hossack . .	IV East .	20, 21 & 22	149, Russa Road.	" B. B. Sircar.

In addition to the above-mentioned medical officers, Miss Trail Christies, M.D., M.S., London, and eight English nurses (six, Misses L. Foxlee, Scott, Bradshaw, Evans, Campbell and Chick, being engaged in England especially for plague duty; two, Misses M. Read and Carlisle, being engaged in India) were employed by the Municipality. In addition to the above the Manicktolla Hospital, with Assistant-Surgeon Lloyd and Mr. Catania in subordinate charge, was kept up by the Municipality. The hospital at No. 5, Budge-Budge Road was ready, but a special staff was not appointed, the Hospital being in charge of No. IV West District Medical Officer, who also had his office there. A hospital in Marcus Square, Ward VI, was similarly kept ready. Grants were also made by the Municipality to the Medical College Hospital authorities towards the maintenance of plague patients. Two military officers, Captains Ward and Rainey, assisted and directed the Ward Vigilance Committees in looking after sanitation. These officers reported directly to the Chairman of the Corporation. The disinfecting gangs, four in number, each consisting of an Inspector and four coolies, were under Dr. Pettifer, who also acted as Assistant to the Special Health Officer.

6757. You put in a table showing the distribution of the plague cases monthly?—Yes, it is as follows:—

Months.	Attacks.	Deaths.
April	37	28
May	33	31
June	77	57
July	43	39
August	29	25
September	11	12
TOTAL CASES . .	230	192

6758. Have you any observations to show any relation between the number of deaths and the temperature?—No. The most noticeable feature is the low mortality from all causes that has prevailed during the months that plague existed in Calcutta. The general mortality curve for this year follows fairly closely the curve for the previous five years, but at a lower level. I consider this general low mortality to be due to the exodus that took place during the scare in April last, and to the influences that have affected the surrounding districts and towns of Bengal, namely, the usual mortality that occurs when a year of plenty follows several years of drought culminating in a famine as occurred last year in 1897. That a similar low mortality prevailed in the part of Bengal in which Calcutta is situated this table. which I put in, shows:—

Mortality in towns near Calcutta.

Name of Town.	Period four months, May to August, 1898 mortality per 1,000 per annum.	Average mortality of previous five years, May to August.	Decrease or increase this year.
(*a*) Calcutta . .	25·56	29·06	—3·5
(*b*) Do. deducting 50,000 for exodus.	27·58		—1·48
Hooghly . . .	30·75	35·88	—5·13
Howrah . . .	15·52	18·915	—3·39
Krishnagar . .	21·24	21·36	—0·12

Mortality in districts around Calcutta.

Name of District.	Period, four months, May to August, 1898 Ratio per 1,000 per annum.	Average mortality of previous five years for the same months.	Decrease or increase, this year.
Hooghly	21·27	27·21	—5·94
Howrah	23·64	23·58	+0·06
24-Pergunnahs	16·5	18·99	—2·49
Nuddia	1·68	23·94	—4·26
Calcutta (*a*)	25·56	29·36	—3·5
Calcutta deducting (*b*) 50,000 for exodus.	27·58		—1·48

Further, taking the average of all the *towns* of Bengal for these four months, a decrease of 6·38 below the quinquennial average is found. Further, all the *districts* of Bengal show a decrease of 6·3 below the quinquennial average for these four months from May to August also. These statistics show that the present mortality in Calcutta is relatively correct, and not due to concealment of deaths or the removal of dead bodies, as has been suggested. The statistics are compiled from the monthly vital statistics issued by the Sanitary Commissioner of Bengal.

6759. How many people were inoculated after July 22nd?—Owing to the small amount of plague, the absence of scare, and the removal of the office from the Health Office to the Town Hall, the number of people seeking inoculation decreased rapidly, until only those who desired to travel by rail, without suffering the inconvenience of detention at the inspection camps, came for inoculation, the number of people inoculated being 31.

6760. The table you have put in showing the distribution of plague cases monthly refers, I think, only to cases that occurred up to the 24th September?—Yes.

6761. I want to know from you if you can tell us if any cases have occurred subsequently and when?—Yes, cases have occurred.

6762. Will you kindly make a statement as to what cases and when?—I did not come prepared to give evidence on the point; there are certain cases which I considered were plague in this list which I give, and there is another since then which I have reported confidentially as a case of plague. Of course my opinion might not be accepted. The list is as follows:

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Cases of Plague after October 1st, 1898, in Calcutta.

Date of first information.	Name.	Age.	Sex.	Caste: Religion.	Place of residence.		Result (summary).	Remarks.
					Ward.	Street and number of house.		
7th October.	Chand . .	20	M.	Hindu (Hawker)	5	381, Upper Chitpur Road.	Died, 12th October 1898.	Treated in Medical College Hospital. Pneumonic.
17th October.	Jugal Kissur .	24	M.	„ Marwari	7	76, Cross Street	Recovered, November 17th.	Treated in a family hospital. Reported by a Practitioner. Bubonic.
17th October.	Beni Chowdhury	25	M.	„ . .	7	55/2. Cotton Street.	Died, 17th October 1898.	Reported by Principal, Medical College Hospital. Stated to have been 24 hours in Calcutta; came from Bankura. Bubonic.
24th October.	Bhadu . .	20	M.	„ . .	6	3, Singhee Bagan.	Died, 24th October 1898.	Reported by Principal, Medical College Hospital. Pneumonic.
2nd November.	Grandson of Umcar Mull.	4	M.	Marwari .	5	45, Burtolla Street.	Died, 2nd November 1898.	Reported by a Practitioner. Bubonic.
2nd November.	Ramrick Nathu	18	M.	Hindu . .	5	71, Burtolla Street.	Died, 2nd November 1898.	Ditto.
17th November.	Balgobind .	12	M.	„ . .	7	76, Cotton Street.	Died, 23rd November 1898.	Reported by Principal, Medical College Hospital Bubonic. Came from Gya 12 days previously.
21st November.	Padarot .	20	M.	„ . .	5 or 7	Burra Bazar .	Died, 21st November 1898.	Reported by Principal, Medical College Hospital. Bubonic. Came from Gya 12 days previously.
26th December.	Ram Killawan	32	M.	„ . .	6	7, Boloram Dey's Street.	Died, 27th December 1898.	Reported by Secretary, Mayo Hospital. Bubonic. Came from Benares 10 days previously.

6763. So far as you know, these have been cases of plague?—They have in my opinion. I feel sure about it. There have been a certain number of suspicious deaths in which I can get no other evidence; I can only suspect; but with regard to these cases I have a certain amount of evidence.

6764. The first case which you have marked occurred on the 7th October; upon what grounds have you entered this as a case of plague?—This case died in the Medical College Hospital; it was reported by the Principal to me as a case of plague.*

6765. In the opinion of the Medical Officer?—Yes, confidentially.

6766. That was a fatal case?—Yes.

6767. Was there a *post-mortem* examination?—I believe there was.

6768. You were not there?—No.

6769. What is the second case?—The second was one which recovered. It was seen by myself and Colonel Harris, Superintendent of the Medical College Hospital; but it was treated in a private family hospital, an isolated room in a building. I had it removed there.

6770. What were the clinical features?—The clinical features were very definite; I can give you the history if you wish.

6771. They were clear in your opinion?—Yes, with a well marked bubo.

6772. (*Mr Hewett.*)—What are the names of these cases?—The first case was named Chand, and the second Jugal Kissur.

6773. Is that the one which Colonel Harris saw?—He saw it with me in consultation; he will be able to give evidence. It was also treated by Dr. Kailas Chunder Bose.

6774. (*The President.*)—That case recovered?—Yes.

6775. What was the third case? - That was the man named Beni Chowdhury. This also occurred in the Medical College Hospital, and it was reported by the Superintendent of the Medical College Hospital. That is the case to which I refer further on in my evidence as having been subjected to a bacteriological examination.

6776. Between what dates have these cases occurred?—The first one was on October 7th and the last died on December 27th.

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* NOTE.—This case was treated as one of simple pneumonia, and was not found to be a case of plague till a *post mortem* examination was made on October 12th.

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6777. In your opinion all these were cases of plague?—Yes. The last case was a man named Ram Killawan, who died in the Mayo Hospital on 27th December.

6778. (*Prof. Wright.*)—Is he a resident of Calcutta?—He had come from Benares ten days before his death. That is all the evidence I can get. He had come within that time, but whether it was imported or not I do not know.

6779. (*The President.*)—You have enquired into the history of these cases?—Yes. Colonel Hendley can give you the reports.

6780. Were they generally imported; was there evidence to show whether they were generally imported cases or not?—In several of these cases there was a history of importation. The case of Beni Chowdhury, the third case, came from Bankura. I got information from the Magistrate that he had come from there.

6781. A special report of each case is in Colonel Hendley's possession, I understand?—Yes, these cases have been specially reported; you can have full details of them. I think there are a certain number of deaths now occurring. For instance, I have information of five deaths occurring in a house, but I can get no certain information.

6782. You did not learn anything until the deaths had been reported?—No, and then there was no professional evidence.

6783. Did you adopt the same precautions in these cases as in ordinary plague?—Exactly the same.

6784. (*Dr. Ruffer.*)—You have reason to believe that there have been other cases besides the cases entered in this list?—Yes, I think so. I have no evidence; it is only a suspicion.

6785. (*Mr. Hewett.*)—You think plague has continued to exist in Calcutta after it was declared to be free from it?—Yes, I think so. I do not think all cases of plague have been reported since the commencement of the outbreak, because they have not been discovered. I think the cases are very much fewer now.

6786. (*Prof. Wright.*)—How do you come to know of these cases: are they all hospital cases?—From the hospital figures and reports from the Medical Officers in charge of the hospitals.

6787. Were these nine cases hospital cases?—Five were in the Medical College Hospital and the ninth was in the Mayo Hospital, also a Government Hospital.

6788. How did you learn about the others?—The other three on this list were reported to me by Dr. Bose, but confidentially, because it would injure his practice if it got known that he reported cases.

6789. Six cases out of nine in that list were hospital cases?—Three were reported to me by Dr. Bose, five were in the Medical College Hospital and one in the Mayo Hospital.

6790. Six altogether in public hospitals?—Yes.

6791. Are all the reports of plague supposed to come to you; has every medical practitioner in the town to report cases to you?—Under the Plague Regulations they are ordered to do so under penalties.

6792. And they do not now report to Dr. Cook, do they?—They are supposed to report specially to me, but there is a little confusion. Sometimes the reports are sent on by Dr. Cook; they go to him by mistake.

6793. Previously all matters connected with plague were reported to him, and now they are all reported to you?—Yes.

6794. (*The President.*)—You had only three cases out of nine which have not been treated in the public hospitals?—Yes.

6795. And you had information about those three from one single practitioner?—Yes.

6796. He gave information with considerable hesitation?—He says he loses his practice by it, because he has a name for reporting cases, and that a rival man gets his practice because he has a name for suppressing cases.

6797. I suppose the proportion of people who die in the hospital is very small compared with those who die outside?—Naturally.

6798. It is infinitesimal I suppose?—Yes.

6799. (*Prof. Wright.*)—Do you as Special Health Officer for Plague, give advice to the Plague Commission which superintends the plague operations?—I look after the plague returns and watch the mortality and death reports and what organisation there is for dealing with plague under the Chairman of the Corporation.

6800. At ordinary times the Sanitary Commissioner looks after the Province and the Health Officer for Calcutta looks after the town?—That is so.

6801. That state of things is changed now, and there is a Plague Commission which looks after plague?—Yes; for the whole Province. The Sanitary Commissioner, I believe, advises the Plague Commission on the points; he does not act entirely independently with regard to plague, and in Calcutta I do the same through the Chairman of the Corporation.

6802. Before, it used to be the Municipal Officer?—Yes, the Health Officer.

6803. You have some facts as to plague acquired by accidental inoculation; you have four cases, I understand?—I only saw one personally.

6804. The man you speak of inoculated himself on the 3rd June; do you remember how he inoculated himself?—He assisted in a *post-mortem* examination which I did of a well-marked case. He was said to have injured his hand, but when he became ill and I examined his arm on the side on which the bubo was, I could not find anything. There was an abrasion on the other hand.

6805. Had the man any cut on his hand while making this *post-mortem*? I was told he had, but I could not find it; he had not on that side but there was a small cut on the opposite side.

6806. You say you were informed on June 8th that he was ill; had he been ill for any period before that or was this the first day he felt ill?—He was said to have had fever for two days, and from his appearance I should think that was so.

6807. That would be the third day after assisting at the *post-mortem* examination?—Yes.

6808. You refer to another case recorded by Surgeon-Captain Prall; do you know whether that case is reported? It was in the *Indian Medical Gazette*, No. 7, for July, 1898, the previous number to the one in which I reported this case.

6809. You speak of some dark coloured tumours you found at a *post mortem* examination of a plague case; did you find them in the same region where the buboes were?—There were suspicious circumstances in the case and at first I thought they were due to blows as the body was sent to the Morgue by the Police, but there was no abrasion of any sort. They did not look like ordinary blows, and I noticed there was some fulness in the groin. I noticed a very large gland which had a typical appearance of plague. These swellings were not over the site of the gland.

6810. Where were these bruise-like swellings?—There was one on the left breast about an inch and a half long and three-quarters of an inch broad, another on the left leg and a third on the skin over the left scapula.

6811. (*Mr. Hewett.*)—Are you responsible for the records of the forty-six cases of plague which took place after Dr. Cook gave up charge?—Yes.

6812. How many of those were males and how many females?—From the 1st August to the time Calcutta was declared free there were 37 cases, because, Dr. Cook has already included up to 31st July in his tables.

6813. That is, 37 deaths?—Yes.

6814. How many attacks?—Forty-one.

6815. How many males, and how many females?—Four females and 36 males.

6816. That is a very large proportion of males?—A very large proportion.

6817. Were all those 40 people taken to the hospital?—Where the cases were not found out till after they were dead, of course they could not be; when they were found living they were either removed or allowed to go into a family hospital.

6818. What was done with the contacts?—They were kept under observation.

6819. And was the house disinfected?—Yes, of course, and that part was vacated; they went into the neighbouring rooms.

6820. Since Dr. Cook gave up charge of the Health Office, so far as it relates to plague, there have been hardly any inoculations?—Hardly any.

6821. Inoculation is absolutely at a standstill at present, is it not?—Yes, there are no applications, and people are not

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afraid now. All I have had are from people who want to travel.

6822. There have been about 30 operations in five months?—Yes.

6823. Have you had instances in which the fluid has not been sterile?—I have not carried out experiments in any other instances, but I should like to say that I used one bottle of Haffkine's serum for a case and six weeks afterwards I thought I would see if one could use it again. I inoculated three tubes after six weeks and they were still sterile. I opened the bottle with precautions of course.

6824. What is the present state of health of Calcutta generally?—It is fairly good.

6825. Is the death-rate above the average?—Below the average.

6826. Is this true of the towns and villages in Bengal outside Calcutta?—As far as my inquiries went the same remark applies.

6827. (*Dr. Ruffer.*)—We have had it in evidence that from 150,000 to 200,000 people had left Calcutta when plague began. Have these people returned to Calcutta?—In my opinion they have now.

6828. Then the low mortality refers to the total population of Calcutta, and not to the population after the people had fled?—I have allowed for the exodus in the table and the mortality is still below normal.

6829. Have you had a good deal of experience in the poorest classes?—Yes.

6830. You have never seen cases resembling plague before?—No.

6831. You do not know of any disease resembling plague?—I do not. I think a well-marked plague case is very characteristic indeed.

6832. You have no reason to suppose that plague is epidemic?—No, I do not think so.

6833. (*Mr. Hewett.*)—While you have been Health Officer have you made any investigations as to the movement of plague from house to house by means of human beings or rats?—I have not traced any connection except in those cases which I have given in my précis of evidence, which went to Barisal.

6834. We shall get those from Dr. Justice, shall we not?—Yes, the cases in Barisal; some from Calcutta are in this précis.

6835. The name of the owner of the house from which the cases spread was Kaviraj Dwarka Nath Sen?—Yes. The Kaviraj kept a sort of medical school, many of its students being boarders and others only day students, and the following diagram shows how cases of plague occurred among the pupils and persons connected with them in Calcutta, Chausa and Backergunge:—

Diagram showing the cases connected with Kaviraj Dwarka Nath Sen's house.

- Pupils of Kaviraj Dwarka Nath Sen, 31 Prosanna Coomar Tagore's Street.
  - (1) Kedar Nath Bhattacharji, Died 16th August, Calcutta.
  - (2) Basanta Kumar Das, Died 23rd August, Calcutta.
  - (3) Madhu Sudan Bhattacharji, Died 29th August, Calcutta.
  - (4) Sita Nath, while in Girija's house, Died 31st August, Calcutta.
    - (*a*) Girija Prosanna Rai, Died 5th September, Backergunge.
      - Binodini, Girija's wife, Died 12th September, Backergunge.
    - (*b*) Upendra Nath Rai, nephew of Girija, Died 4th September, Backergunge.
    - (*c*) Tarak, servant of Girija, Died 5th September, Backergunge.
      - (1) Lakhi Some, Brother-in-law of Tarak, Died 9th September, Backergunge.
      - (2) Mukta, wife of No. 1, Died 16th September, Backergunge.
      - (3) Ramani, Sister of Tarak, Died 16th September, Backergunge.
      - (4) Ramnidhi, neighbour of No. 1. Died 16th September, Backergunge.
      - (5) Baikuntha. Father of Tarak, Died 17th September, Backergunge.
      - (6) Harsundari, wife of No. 4, Died 22nd September, Backergunge.
      - (7) Kamini, wife of No. 5, Died September, Backergunge
    - (*d*) Dr. Amulaya Churn Bose, who attended Sita Nath, Died 4th September, Calcutta.
    - (*e*) Puddomoni, maid-servant of Girija, Died 8th September, Calcutta.
    - (*f*) Shashi Bhusan Sen, who attended on Sita Nath Died 4th September, Calcutta.
  - (5) Bishnadutt Bramhacharji, Died 31st August, Chausa.
    - Compounder, who attended him, Died 6th September, Chausa.

6836. Five of the people attending the lectures died of plague in the course of fifteen days?—Yes.

6837. One of them named Sita Nath lived in the house of a gentleman named Vakil Girija Prosanna Rai?—Yes.

6838. Who had relatives in Backergunge?—Yes.

6839. And Girija Prosanna Rai left Calcutta for Backergunge?—Yes.

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6840. You have heard what happened in Backergunge?—Yes. I enquired into these deaths; I never saw any of them personally.

6841. The doctor, Amulaya Churn Bose, who attended on Sita Nath, Shashi Bhusan Sen who also attended on him, and the maid servant of Girja Prosanna Rai all died?—Yes.

6842. There was also a compounder who died at Chausa?—Yes, the fifth of the students did not die in Calcutta but went to Chausa and died there, and the compounder who attended him died there also six days after the student died.

6843. (*Dr. Ruffer.*)—The case of Sita Nath was a pneumonic case, was it not?—From what I saw and from Dr. Justice's report I should say they were all pneumonic; there was not one with marked bubonic plague.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Home Office, Calcutta.

TWENTIETH DAY.

Friday, the 30th December 1898.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX, (*Secretary*).

MAJOR J. B. GIBBONS, I.M.S., called and examined.

Major J. H. Gibbons.

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6844. (*The President.*)—You are a member of the Indian Medical Service, Superintendent of Campbell Hospital, and Police Surgeon in Calcutta?—Yes.

6845. (*Dr. Ruffer.*)—I believe you examined, on 13th November 1896 at 7-30, the body of a man named John Marcellies, and you give here* an account of the *post-mortem;* was that case in your opinion one of plague?—Yes. That was in 1896; I now say positively that that was not a case of plague, having seen plague this year.

6846. Did you find any micro-organisms in the preparations of the blood?—I did not examine these preparations; Dr. Simpson and Dr. Cobb took away blood from the heart in that case and they found nothing; they told me so afterwards.

6847. And the saphena glands were enlarged? Yes.

6848. What do you mean by the saphena glands?—The femoral glands.

6849. They were enlarged?—Yes, but it is very common to find these glands enlarged; all glands are very commonly enlarged among the natives. That gland at that time was about the size of a rupee.

6850. And the glands in the other parts of the body?—None of them were enlarged.

6851. Then you speak of the lungs; was the fluid in the lungs examined microscopically?—No; Drs. Simpson and Cobb took blood from the heart, and also from one of the femoral glands, and also split the gland and they found nothing.

6852. The *post-mortem* was made 24 hours after death, was it not?—I made the *post-mortem* in the morning; the man died the previous afternoon. Drs. Simpson and Cobb made their investigation about 10 o'clock at night before I made the *post-mortem.*

6853. He died on the 12th and you examined the body on the 13th?—Drs. Cobb and Simpson went to the Morgue that night. They came to my house at 9 o'clock at night, and went to the Morgue and took specimens, a few hours after death.

6854. They made their preparations then?—Yes, and they were negative.

6855. They found no micro-organisms?—Nothing.

6856. (*Mr. Hewett.*)—You did the *post-mortem* in the first case this year?—Yes.

6857. Did you come to the conclusion at the *post-mortem* that it was a case of plague?—No, I suspected it. I had to give an opinion and I refused to give a definite opinion until it was investigated bacteriologically.

6858. Was your opinion that the man died of acute blood-poisoning, and that a bacteriological examination was necessary to determine whether it was plague or not?—Yes, I had never seen a case of plague at that time. I may say that the dome, the assistant at the *post-mortem*, was the man who was inoculated in his hand.

(Witness withdrew.)

MAJOR EVANS, I.M.S., called and examined.

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6859. (*The President.*)—You are Resident Officer at the Medical College Hospital in Calcutta?—Yes.

6860. And also Professor of Pathology?—Yes.

6861. (*Dr. Ruffer.*)—You have handed in a table of the cases which have come under your notice. I suppose you put that in evidence?—Yes. The information, which I am in a position to submit regarding the outbreak of plague in Calcutta, concerns chiefly those cases of the disease which were treated in the Medical College Hospital. These cases constitute about one-third of the total number that have occurred in Calcutta. They were admitted from that part of the town in which the first cases arose, and in which, I understand, the majority have occurred. The proportion which the Medical College cases bear to the total number recorded, the locality in which the disease was contracted, and their varied incidence as regards race entitle them, I think, to be regarded as fairly representative of the whole outbreak. With few exceptions, the cases were treated

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* See Appendix No. XXI in this Volume.

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in the contagious wards of the hospital, which are under my medical charge. The following table shows the number and type of cases admitted, their incidence as regards race, and the result :—

	Europeans.	East Indian.			Natives.			Chinese.			Burmese.			Total deaths.	Total recoveries.	Grand Total.
		Died.	Recovered.	Total.	Died.	Recovered.	Total.	Died.	Recovered.	Total.	Died.	Recovered.	Total.			
Bubonic	...	3	6	9	41	12	53	1	...	1		...	...	45	18	63
Bubonic and Pneumonic .	...	...	...	...	4	...	4	...	...	...	...	...	...	4	...	4
Pneumonic . . .	...	...	...	...	10	...	10	...	...	...	...	...	...	10	...	10
Septicæmic . . .	...	6	...	6	14	...	14	...	...	...	...	...	...	20	...	20
Bubonic and carbuncular .	...	...	...	...	...	...	...	...	...	...	1	...	1	1	...	1
TOTAL .	...	9	6	15	69	12	81	1	...	1	1	...	1	80	18	98

Note 1.—Mortality 81·6 per cent.

Note 2.—Forty-four *post-mortem* examinations were made, two being conducted by Dr. Bird and Dr. Green, the remainder by myself.

Note 3.—In five cases of bubonic plague, plague pneumonia was observed. In four of them, the lung affection had assumed such important proportions that the cases are described as bubonic plague and pneumonic.

The majority of the cases admitted to the Medical College Hospital came, roughly speaking, from the area lying between Harrison Road on the north, the New Market on the south, Wellesley Street on the east, and Bentinck Street with Chitpur Road on the west. This neighbourhood is one of the oldest parts of Calcutta and is very populous. Natives of India constitute the main part of the population of the district, but besides natives, there is a very considerable community of Europeans and Eurasians, many of them very comfortably off, a large colony of Chinese, a few Burmans, and a number of families of African descent. The buildings are one and two storey brick houses, mostly old, and native huts of the kind usual in Calcutta. Except in the Marwari quarters, very few of the buildings are either large or lofty. Several wide main thoroughfares traverse the district, but the intersecting streets are tortuous and so narrow that at their widest part a couple of vehicles can barely pass. In the native huts and houses overcrowding during the night is apparently common, and can often be easily observed, for the windows are not always furnished with shutters. It is no uncommon sight to see the floor of a room covered with sleeping men lying in close proximity. Over 80 per cent. of the patients were natives of India. Fifteen East Indians, one Chinaman and one Burman constituted the remainder. No African was admitted with this disease.

6862. I notice you state that there are a good many Chinese and Burmese people in the district, but I find that only one Chinese and one Burman died; so that they appear to have a considerable immunity from plague?—Yes.

6863. Can you account for that in any way?—I may say that the number of Burmese is very small, at least it is not large. I could not give even approximately the number of Burmese; it is small compared to the number of Chinese. The number of Chinese is very considerable, I believe some thousands, and they are people who are well to do; they wear boots.

6864. They always wear boots, do not they?—I have not noticed any of them going about without boots; and I have been inclined to attribute their freedom to the fact that they are better off and they wear boots.

6865. But boots would not prevent them from getting plague through their hands?—No, perhaps their work does not bring them into contact with the soil in the same way as other people.

6866. What is their work?—Chiefly boot-makers and carpenters. The Burman had a cervical bubo and had a little pimple on the face which developed into a carbuncle.

6867. What do you mean by "East Indians"?—I mean Eurasians.

6868. I see very few of them died; is there a large community of Eurasians?—Yes, there is a large community. We had only fifteen cases of East Indians in the hospital.

6869. And of these nine died?—Yes.

6870. Is this not a very small proportion as compared with the natives?—Certainly.

6871. Do a large number belong to the Christian community?—Yes, they are chiefly East Indians, but there are pure natives as well.

6872. And none of them got the disease?—No pure European was admitted with this disease, and only one native Christian.

6873. What is the proportion of Europeans to natives, Chinese, Burmese, and so on in the hospital?—During 1898 the proportion was as follows:—Europeans, 5·8 per cent.; Eurasians, 29·7 per cent.; Natives, 55·7 per cent.; other classes, 8·8 per cent. The term "other classes" includes Chinese, Burmese, Japanese, Jews, Native Christians, Armenians, etc.

6874. Then you hand in a statement as to the meteorological conditions prevailing in the first part of the present year?—Yes. It is as follows:—

"To the ordinary observer, the weather was unusual during the first quarter of the year. I was interested in the fact at the time, as it called forth the prediction that cholera would be later in appearing and might display less intensity than had characterised it in 1896 and 1897, two rather bad cholera years. In order to obtain an exact scientific description of the unusual meteorological conditions prevailing, I have applied to Mr. Little, the Meteorological Reporter to the Government of Bengal. Mr. Little has very kindly furnished me with the following statement with permission to embody it in my abstract. The depression in February without rain, the prevalence of dry westerly winds, and the unusual prolongation of the cold weather, are, I think, very interesting features.

"The following is a brief statement of the more noticeable peculiarities in the weather in Lower Bengal in the early months of the present year:—

"The cold weather was in some ways later than usual in commencing, and a possible consequence of the late beginning was the settled weather during January with less rain and cloud than usual. Temperature on an average for the month was below the normal. The cold-weather storms which cause in January and February periods of high humidity, cloud and rain, and are accompanied by rapid changes of pressure and temperature, were three or four weeks later than usual in beginning, that is, the first disturbance occurred towards the end of January instead of near the beginning.

"There was nothing noticeable in the early part of February, but about the middle of the month a very marked departure appeared and continued during March. This was a greater dryness of the atmosphere than usual, shown by low humidity and an almost entire absence of cloud and rain. Also a familiar feature of cold weather mornings, *viz.*, a dense low-lying fog, was of very rare occurrence.

"The following tables show the rainfall, etc., as observed at

Stations in the Presidency Division from January to March :—

Mean daily temperature and variation from the normal.

	JANUARY.		FEBRUARY.		MARCH.	
	Temperature.	Variation.	Temperature.	Variation.	Temperature.	Variation.
Saugor Island	66·1	−2·0	73·1	+0·2	79·2	−2·0
Calcutta .	64·9	−1·3	70·7	0	79·2	−0·9
Krishnagar .	63·7	−1·1	68·7	+0·9	77·5	−1·3
Berhampore .	64·2	−0·9	68·3	−0·7	...	...
Jessore .	63·9	−1·7	69·4	−0·5	78·3	−2·1

Average Humidity at 8 A.M., and variation from the normal.

	JANUARY.		FEBRUARY.		MARCH.	
	Humidity.	Variation.	Humidity.	Variation.	Humidity.	Variation.
	°		°		°	
Saugor Island	89	+1	81	−11	81	−9
Calcutta .	84	0	78	−6	75	−6
Krishnagar .	84	...	75	...	60	...
Berhampore .	88	+8	81	+6	61	−8
Jessore .	85	+2	77	−5	70	−12

Average Cloud at 8 A.M., and variation from the normal overcast sky is represented by 10.

	JANUARY.		FEBRUARY.		MARCH.	
	Cloud.	Variation.	Cloud.	Variation.	Rainfall.	Variation.
Saugor Island	0·9	−1·4	3·5	+0·4	2·0	−2·2
Calcutta .	0·5	−1·4	3·1	+0·9	0·7	−1·8
Krishnagar .	0·6	...	3·1	...	0·9	...
Berhampore .	0·6	−1·1	2·7	+0·9	0·5	−1·9
Jessore . .	1·0	−0·9	3·0	+0·7	1·1	−2·0

Rainfall and variation from the normal.

	JANUARY.		FEBRUARY.		MARCH.	
	Rainfall.	Variation.	Rainfall.	Variation.	Rainfall.	Variation.
	Inches.		Inches.		Inches.	
Saugor Island	0·47	+0·05	0·28	−1·08	0·16	−1·32
Calcutta .	0·36	−0·24	Nil.	−1·38	Nil.	−1·57
Krishnagar .	1·21	+0·87	0·26	−0·94	0·01	−1·69
Berhampore .	0·38	−0·07	0·08	−0·80	0·04	−1·02
Jessore . .	1·14	+0·72	0·05	−1·15	Nil.	−2·02

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Table showing average rainfall in the six Divisions of Bengal expressed as a percentage of the normal.

	JANUARY.	FEBRUARY.	MARCH.
Orissa . . .	...	16	...
Chota Nagpur . .	2	116	3
South-West Bengal .	120	16	2
East Bengal . .	177	31	8
Bihar . . .	38	200	23
North Bengal . .	119	162	6

"The rainfall table just above has been given, because it shows that rainfall was largely deficient in the south, but not to the same extent in the north of the province. The exceptional dryness of the air and the absence of cloud and rain in Lower Bengal were probably due to the course followed by the disturbances on which the weather during the first three months depends. The central area of depression instead of moving westward over the central districts of Bengal was generally further north—in fact was over the Himalayas instead of the plains. Dry westerly winds, therefore, prevailed in Bengal instead of the irregular or cyclonic winds which are accompanied by inrush of moist air from the Bay of Bengal and ascensional movements with increase of humidity and precipitation.

"The cold weather conditions were unusually late in ending. Even as late as the second week of April the pressure distribution characteristic of the cold weather months was restored for two or three days with northerly winds and low temperature.

"During April rainfall, though still comparatively deficient, was better distributed and in fair quantity."

6875. Do you think that these meteorological conditions had anything to do with the prevalence of plague at one particular time of the year?—I am not in a position to pronounce an opinion, and the matter is not one regarding which a dogmatic statement is possible. Still it is a matter of very considerable interest that the meteorological conditions were distinctly unusual, and the Meteorological Reporter, Mr. Little, supports the observation in the note he has been kind enough to give to me. The incidence of cholera may, however, in my opinion, be legitimately associated with the meteorological conditions as this is a matter on which we have more experience. The incidence of cholera was very unusual.

6876. What were the observations with regard to the occurrence of other diseases in the current year?—Cholera was less prevalent than usual, and at the commencement of the year there was an unusual number of cases of influenza.

6877. I believe cholera makes its appearance about the middle of February?—Yes, about then.

6878. Did it appear later this year?—Not only later but there was less of it. I may mention, as a matter of interest, that just now during the present week an unusual number of cases of cholera have come into hospital. It is very seldom that we get cases of cholera in the Medical College Hospital during Christmas week. But three or four cases have been admitted during the last few days.

6879. You hand in a table of cholera cases which have been admitted to the hospital?—Yes. The following table shows the number of admissions for cholera to the contagious ward of the Medical College Hospital for the months of February, March, April, May, June, October and November during the years 1895, 1896, 1897, 1898 :—

	1895.	1896.	1897.	1898.
February	10	22	24	11
March	25	55	69	12
April	21	86	47	17
May	10	41	36	3
June	4	21	24	1
October	10	5	7	3
November	18	5	7	...
TOTAL .	98	235	214	47

6880. With regard to the introduction of plague into Calcutta, are you of opinion that the cases occurred chiefly

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among people who had not left Calcutta?—Yes. I asked the people where they came from, and made general enquiries about them, and, as far as I could ascertain, they were people who had been living in Calcutta for a considerable time.

6881. Are you satisfied none of them were imported cases?—The information was derived from their friends and from themselves as far as practicable, and so far as we can make out in a general way they were people who had been living here for some time. Sometimes patients came without friends who knew anything about them, and were very ill and it was difficult to be quite sure.

6882. How do you think the plague entered Calcutta?—I cannot pronounce an opinion worth much; it seems to me that it has not been brought by people but must have come in infected articles.

6883. Why do you say it came in infected articles rather than in infected people?—There has been a very careful scrutiny of all people coming into Calcutta, and it is hardly possible to believe that an individual with plague could pass undetected through the various points of observation. They have to pass through so many barriers. I do not think persons suffering from plague could come by sea. That seems impossible.

6884. Why?—Because most of the steamers coming round from Bombay are coasting steamers and take three weeks and even longer on the voyage.

6885. Have there not been two cases in London which came there by sea?—Two such cases have been reported, but the latest information questions their being really cases of plague.

6886. Is that not quite as long a voyage as from Bombay to Calcutta?—Yes, still the period of incubation is a moot point; and, granting the two cases imported into London from Bombay to be *bonâ fide* cases of plague, they might have infected themselves from infected articles on the voyage.

6887. You think that the measures which have been taken on the railway were sufficient to exclude all possibility of plague coming by train?—That is the opinion which I have formed.

6888. What is the period of incubation of plague?—The longest period of incubation concerning which I have any personal knowledge occurred in the case of the medical student who assisted at a *post mortem*, and developed plague 14 days subsequently. So far as is known there was no other source of infection, except this *post mortem*.

6889. So that a person starting from Bombay could easily come into Calcutta with plague on him?—The student might have acquired the disease from his clothes on some day subsequent to that on which he assisted at the *post mortem*.

6890. But I see in your précis of evidence that you do not think it was brought in by patients, and I want to know why?—I take it they would display some evidence of illness.

6891. Not necessarily during the incubation period and you believe the incubation period to be 14 days?—Ten days has hitherto been regarded as the maximum period of incubation.

6892. A patient might be here seven days without showing any symptoms?—I admit the possibility, but the number of third class passengers who come direct to Calcutta from Bombay by mail train is so very small that the probability of the introduction of the disease by this means is not great.

6893. But there are other infected places besides Bombay?—Yes.

6894. Have you any evidence as to the disease having been conveyed here by clothing?—No.

6895. Or as to its having been conveyed by rats?—No, I have no evidence. The only observation I would make is that cases of plague occurred in Calcutta before the diseased rats were observed.

6896. So that you have no evidence of the disease having been brought in by rats?—No.

6897. You believe in the soil being infected?—It seems to me that this is the easiest solution of the question; because at first there was a number of cases which occurred about the same time in the same locality—roughly in the same locality, though that locality is a large one.

6898. How do you think the soil can become infected from a plague patient?—In many cases shortly before death the urine becomes infected. Hæmorrhage occurs into the kidney and into the mucous membrance of the pelvis and ureter, allowing the bacilli to escape and thus infect the urine. Similarly, vomited matters and sputum may become infected. I have found petechial hæmorrhages into the mucous membrane of the stomach very often after death, and hæmorrhages into the alveoli of the lungs in a certain number of cases. Small hæmorrhages in Peyer's patches were found by me in two *post mortems*.

6899. Do you believe the bacillus spreads through the soil, or that it remains in the spot where it has been placed?—It may be wind-borne.

6900. You do not think it can spread through the soil in any other way?—I think that it may be disseminated by rain, and carried into buildings and other localities by soil adhering to the feet of human beings and animals and the wheels of vehicles.

6901. (*The President.*)—Have you made any observations?—No.

6902. (*Dr. Ruffer.*)—I believe you have had a large experience of other infectious diseases in India?—Yes.

6903. Have you seen any cases resembling plague before this epidemic?—No.

6904. Have you seen in former years any cases which could possibly be mistaken for plague?—No.

6905. Is the diagnosis of plague quite easy?—Especially when several cases occur together.

6906. Do you think that in ordinary times the diagnosis of plague cases is easy?—Not every form of plague,

6907. I am referring especially to the bubonic form?—A very mild case of the bubonic form is not always easy to diagnose.

6908. In four cases you have been able to find the point of entry of the bacillus?—In four cases there was a distinct local lesion.

6909. Can you give us some account of the local lesions which you found at the point of entry?—In three cases there were small blebs containing black fluid, and in one case there was a carbuncle in the cheek.

6910. You considered this carbuncle as the point of inoculation?—It was natural. The carbuncle contained multitudes of plague bacilli. In the other cases the bleb was assumed to be the point of entry, because the bubo was on the side of the local lesion.

6911. Did you find plague bacilli in the blebs?—No, I did not examine the blebs for bacilli.

6912. You have examined a great many cases of plague pneumonia?—Yes, altogether I have examined ten cases of uncomplicated plague pneumonia, and four cases in which pneumonia and bubonic enlargement occurred together.

6913. In cases of typical plague-pneumonia without a bubo, could you tell us what were the *post mortem* and microscopic appearances?—I am sorry I did not bring you a drawing which I have had prepared representing plague pneumonia which occurred in a recent case of plague pneumonia associated with bubonic enlargement; it was fairly typical. Generally speaking, what I have observed is that, on opening the chest, there are to be seen sometimes in one lung, and generally in both lungs, raised, reddish patches on the surface. These raised, reddish-grey patches—they are more reddish-grey than red—vary in size from a sixpence up to a crown piece. The pleura covering these patches is generally inflamed. The patches feel quite solid and are raised above the surface of the surrounding lung. On section of the lung the solid patches are found to be roughly wedge-shaped and reddish-grey in colour, consolidated and pneumonic, and surrounded by a varying extent of splenised lung. In the centre of the lung the patches are more circular and also surrounded by a varying extent of splenised lung, that is to say, lung in which hæmorrhage has taken place into the air-cells. These areas are disseminated over both lungs and over all the lobes. In three cases the pneumonic process had so far advanced that nearly the whole of one lobe in one lung had become consolidated. In one of the three this inflammation of one lobe was the extent of the lung trouble. It was a case of bubonic and pneumonic plague, and cultures of plague bacilli were obtained from the affected lung. The other two were cases of uncomplicated plague pneumonia, and the almost entire consolidation of one lobe was accompanied by small patches of pneumonia disseminated through the rest of both lungs.

6914. Was it a lobular pneumonia?—The smaller areas of pneumonic lung may doubtless correspond to four or five adjacent lobules. The inflammation is, however, very definitely croupous and not catarrhal. In some cases the distribution of the consolidated areas bears a striking resemblance to the condition of the lungs in pyæmia. I would submit that the term lobular pneumonia is wanting in definite significance, and that it is employed to describe conditions differing greatly not only in anatomical details, but also in their etiology and the manner of their production. The term now-a-days conveys nothing, except that the pneumonia is not lobar. It does not appear to me to be applicable to plague pneumonia which displays fairly constant characteristics similar in its primary and secondary developement. The considerable size and complete consolidation of the pneumonic areas, their arrangement in the subpleural portion of the lung, their shape and their rapid developement suggested to me that the bacilli were hæmatogenous rather than pneumatogenous.

6915. Do they look at all like infarcts?—No, I would not say they are like infarcts. The lung is reddish-grey, and on section the air cells in the pneumonic portion are found filled with a fibrinous exudation. Around the central consolidated portion is often an area of splenised lung, the air cells of which are filled with extravasated blood. Masses of bacilli are to be found in the alveoli of the consolidated portion of the lung. I have not been able to make out in the consolidated portion of the lungs that the bacilli have the same distribution that Klein has described in inoculated Guinea pigs, *viz.*, that they are contained in the capillary blood-vessels. So far as I have yet seen in man the plague bacilli occur in large masses in the air-cells.

6916. Did you find a large number of bacilli in the bronchi?—I have found them there. Of course there is such a variety of organisms when one comes to deal with the larger bronchi. On the other hand I have several times been able to obtain pure cultures of plague bacilli from the consolidated portion of the lungs. In two cases, instead of the reddish-grey nodules in the lungs surrounded by hæmorrhagic lung, I have seen what one might describe as small wedge-shaped areas of "white hepatization" resembling somewhat the small wedge-shaped masses of secondary cancer, that form on the surface of lung. While fresh they recalled the appearance of a white infarct of the kidney. These white patches, which were either wedge-shaped or circular, contained plague bacilli in great abundance. They were quite firm.

6917. Were buboes present in these two cases?—One was bubonic and the other was an uncomplicated pneumonia case.

6918. I suppose you may have two forms of pneumonia in plague; you may have primary plague pneumonia and secondary plague pneumonia from the bubo?—Quite so. In four of my cases the pneumonic symptoms were so prominent that I labelled the cases bubonic and pneumonic. In these cases the bubonic enlargement was very considerable. So far as I have yet seen the character of the pneumonia is the same, whether it be primary or secondary.

6919. So that a case which was primarily bubonic may become exceedingly infectious when pneumonia sets in?—Quite so; but I take it there was one source of infection, that the bubo was the source from which the general infection took place.

6920. Do you think there are cases of primary plague pneumonia with buboes?—That is to say, an infection of the body at two points occurring simultaneously or nearly so. I have no observations to offer. It seems to me to be possible. I should like to say that in two cases of pneumonia there were secondary foci in the liver and in the spleen and in the kidney which I presume were secondary to the mischief in the lung.

6921. You have been in charge of the hospital; have any of your nurses or hospital attendants or any of the friends and relations of plague patients contracted plague in the hospital?—None. There were two instances in the *post mortem* room. Two domes became inoculated with plague, and both developed the disease and died.

6922. You say in your précis of evidence that one died as early as 48 hours after accidental inoculation; when did he first show symptoms of plague?—The period of 48 hours is mentioned in the case of the second dome.

6923. You say in your précis that the first dome scratched his finger on May the 1st, and that he died on May the 3rd; is that a mistake?—No.

6924. Then the incubation period was under two days?—He died on the 3rd; he had a little fever the evening before, and died the next morning.

6925. In that case the incubation period was about 24 hours?—Yes.

6926. The second one had an incubation period of two days?—Yes, about. They are people who will not always declare themselves ill when they are ill. But these are the facts as far as I have been able to gather them. The two servants in question were, however, under my observation a great deal, because I saw them every day.

6927. At the same *post mortem* a medical student was present, who died 14 days afterwards from plague?—Not the same; that was at another *post mortem*.

6928. In this case have you any absolute proof that he did not get plague somewhere else?—No, I have none. He was my laboratory assistant and the work he really did was to make smear preparations at this *post mortem*.

6929. Then you cannot say for certain that the incubation period was 14 days?—Quite so; I am quite ready to admit that, but still the student was under my observation almost every day, until he took to his bed about three days before his death.

6930. When was the last time you saw him before he died?—Three or four days before death. He was working in the laboratory.

6931. Might he not have inoculated himself in the laboratory at any time?—He might, except that everything that was believed to be infected was put in a strong solution of formol. Every precaution was taken—the usual laboratory precautions. So far as I know there was no such inoculation, but of course a remote possibility always remains.

6932. Might he not have inoculated himself in the hospital?—I do not think there was much risk of his doing that in the hospital.

6933. You say "the cases admitted during the earlier days of the epidemic were of a much more virulent type;" I believe the mortality remained the same?—Yes.

6934. But you think the type of the disease changed in the course of the epidemic?—We found it much easier to manage the patients.

6935. Is not that possibly due to your larger experience?—I do not think so.

6936. You think the type of the disease changed?—Yes, instead of five or six persons being required to hold a patient in bed, one nurse or attendant became usually sufficient. At first they were often very violent.

6937. But the disease was quite as virulent at the end of the epidemic as it was at the beginning?—Yes.

6938. Is not that the case in cholera also?—No, it is just the reverse; as the outbreak proceeds the cases become milder and they recover.

6939. In your opinion the number of cases of plague may diminish, and yet the disease remain quite as virulent as during the height of the epidemic?—That was my observation.

6940. You saw some cases in which the buboes became necrosed?—There were four, and two of them recovered, and I was rather impressed by that fact. Two recovered; the other two made a great battle for life. Perhaps I have attached too much value to the observation. I tried to find out whether there was any other process at work besides plague—whether there was a double inoculation, an additional organism antagonistic to the plague bacillus having gained entry into the body along with the plague bacillus.

6941. You mean to say that this observation might be useful in suggesting some method of treatment?—It suggested itself to me in that way. The necrosis of the skin over a very large area was a very striking feature. The last of these four cases came to see me yesterday, and I can produce him. He comes to me from time to time. In his case death of the skin took place over a very large area.

6942. If the bubo became necrosed, may it not have been due to a secondary infection in that bubo,—infection by streptococci for instance?—I am not prepared to say whether the necrosis is due to a developement of the plague process or infection by another organism, either in the first instance simultaneously with plague or secondarily during the course of the disease.

6943. Do you suggest that possibly the cure of this patient may have been due to the secondary infectious process?—I would suggest that it was due to some subsidiary infectious process.

6944. (*Mr. Hewett.*)—In your précis of evidence you refer to the first known case of plague; that is the case on April 17th?—March 30th.

6945. That was not declared to be plague?—No, there was no declaration made at that time.

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6946. That is the case you refer to, and that is the reason you say plague was ascertained before rats died ?—Yes.

6947. (*Prof. Wright.*)—With regard to the diagnosis of septicæmic cases, was that made by an examination of the blood or by the symptoms ?—In the majority of cases by the symptoms, but in some recent cases I have made cultures.

6948. You have convinced yourself that there are cases of plague without any buboes and without any pneumonia ?—Absolutely.

6949. Do these cases run a very rapid course ?—Yes, so far as I have seen.

6950. Have you seen any of them get well ?—No.

6951. With regard to the carbuncle you spoke of, you say it was full of plague bacilli ?—Yes, I have kept some of the tissues.

6952. Did you find any other organism in it ?—No, only the plague bacilli.

6953. That is the only case you saw ?—Yes, that was the only case of carbuncular plague: he died in less than four hours after admission to hospital; the *post mortem* was made an hour after death.

6954. In four cases out of these 98 you found local lesions ?—Yes.

6955. Where were these local lesions ?—One was a bleb on the wrist, two were blebs on the ankle, and the fourth the carbuncle on the cheek which has just been referred to.

6956. Did you examine the body as well as the limbs ?—Yes, the body was examined. In the cases which went to the *post mortem* table the body was thoroughly examined; of course that was not always possible in every case which was admitted to the hospital; I cannot say I made a thorough examination of the whole body of every patient, but I did in every case which reached the *post mortem* table.

6957. It has been suggested to us that lesions produced by skin diseases might prove a likely source of infection ?—I have no observation to offer upon that.

6958. You say you have frequently seen swollen glands occurring quite apart from cases of plague ?—Yes, it is a very common thing for people to get fever and shotty glands both in the axilla and in the groin, which are tender on pressure. The condition is independent of venereal disease.

6959. Have you ever examined any of these cases bacteriologically ?—No, they always recovered; they would object to being examined bacteriologically.

6960. Have you not seen any of these on the *post mortem* table ?—No, I have not. But I have on several occasions been able to obtain material for pathological examination in another way. For the enlargement of the glands which is at first transient and recurrent sometimes becomes chronic, and then patients occasionally ask for their removal. On section such glands are generally indurated, sometimes lymphangiomatous, and occasionally display small necrotic areas which are not tubercular. On the *post mortem* table an enlargement of the mesenteric glands independent of any evident disease of the intestine is not uncommon, but I have not made any bacteriological investigation.

6961. You said you had seen no cases of infection from plague patients occurring in the hospital; do you use any antiseptics in the wards; do the nurses wash their hands with antiseptics ?—They certainly do not wash their hands each time they touch or feed a plague patient. They have done their work very bravely, and, as a matter of fact, I think they wash their hands very seldom while on duty.

6962. Then, you do not use many precautions ?—We do not. The nurses are enjoined to wash their hands and they are thoroughly alive to the risk, because they have received extra pay and so on. The risk has not been concealed from them, but they certainly have not taken very great precautions.

6963. With regard to patients, you say the friends of the patients were admitted to the hospital ?—They were admitted to the hospital; during the time we had a number of plague cases we encouraged the friends to come and stay with the sick.

6964. Did they attend pneumonic cases also ?—They did.

6965. And you saw no cases of infection ?—None.

6966. But these relatives went away immediately after the atients died ?—Yes, as soon as their patients died, and we ad no opportunity of studying them subsequently. I hink if they had been ill they would have come back to us. Very friendly relations were established with them.

6967. (*The President.*)—With reference to what you have pointed out as to the incidence in the different races in Calcutta, I do not think you gave any explanation of that. Can you give any explanation as to how certain races have escaped in the remarkable manner in which apparently they have escaped ?—I said that the Chinese here in Calcutta for the most part are well-to-do. They are well-fed and well-clothed and their feet are protected. Their legs are not protected, but their feet and ankles are. Then they work as carpenters and boot-makers, and are generally better off than the majority of native coolies.

6968. How does that apply to the Burmese ?—There was only one Burman, and the Burmans, like the Chinese, are fairly well-cared for. The number of Burmese in Calcutta is very small.

6969. Let us take the Europeans; how do you account for their freedom ?—I cannot give any explanation which is the result of personal observation. But it has become the custom to attribute it to a certain amount of racial immunity.

6970. Don't you think that habitation and surroundings have to do with it ?—I do not think the answer to the question is to be found solely in the character of the European habitations and surroundings, for many pure Europeans living in Calcutta are very poor, and as much exposed to infection as are the poorer Eurasian community. I was impressed by the fact that no African was admitted suffering from plague, for the number of Africans is very considerable and some of them are very poor.

6971. You have given a considerable amount of space in your printed précis of evidence to the meteorological conditions. I do not think we have had any evidence on the point you wish to draw special attention to ?—The meteorological conditions were unusual.

6972. I fancy that what you have stated here may be taken as your statement on the special point ?—Yes, the note is supplied by Mr. Little, the Meteorological Reporter, and he is an expert in the matter.

6973. You have been asked about the external enlargements of lymphatic gland in fever; you have seen a great deal of that in Calcutta ?—It is very common. The degree of enlargement is nothing approaching to a plague bubo, and the enlarged glands are neither so tender on pressure, nor the source of so much pain as a plague gland.

6974. You mean there is nothing in common between the clinical features of this disease and those of bubonic plague ?—Yes.

6975. And that you have no difficulty in distinguishing between the two ?—That is so.

6976. There are enlarged external glands and there is also fever, I understand ?—Yes.

6977. On what other grounds do you base your distinctive diagnosis, these being two of the most distinguishing features of bubonic plague ?—The enlarged glands are not so tender as in plague, and their condition does not suggest the presence of an intensely active inflammatory process.

6978. They are not much enlarged ?—The enlargement is often very palpable, but it is apparently confined to the gland. So far as I can make out, little or no exudation occurs around the gland in these cases.

6979. Do you mean on palpation you are able to distinguish this enlargement from the enlargement of bubonic plague ?—Perhaps I had better say that I have had no opportunity of seeing cases of so-called *pestis ambulans*, those mild cases of plague which have been described, where there is only transient fever and slight inflammatory enlargement of the gland which subsides without suppuration. I have not seen such cases. The cases I referred to are associated sometimes with filariasis, sometimes with malaria, but may also apparently arise independently of either. The glands display a degree of enlargement and tenderness which subsides after a time, though a certain amount of shottiness may persist.

6980. All that might occur in bubonic plague; I want to get the distinction on which you base your opinion ?—The history, the want of severity, the absence of mortality.

6981. Does the disease last longer ?—An acute attack lasts one week or so. The condition is, however, essentially chronic, but an acute attack may recur at any time. A recurrence is marked by local exacerbation and a varying degree of constitutional disturbance.

6982. And the general prostration is not so great ?—The clinical picture is entirely different. In cases of plague the pyrexia is of remittent type, while in the cases of fever with glandular enlargement it is often intermittent and does not last so long.

6983. The pyrexia does not last so long?—No, and it is usually of a different type.

6984. Everything you have said seems to indicate that the degree rather than the character of the symptoms is different?—Perhaps I do not express myself very well, but I do not think I should make a mistake between the two types of disease.

6985. What I want to get at is upon what grounds you think you cannot make a mistake, because it is very important. Such cases may be simply mild cases of plague. If you had these mild cases, how can you ascertain that they are not cases of plague?—During an epidemic of plague every recent or acute glandular enlargement without ascertainable cause must naturally be viewed with suspicion. Logically I do not suppose it would be possible to settle the question in certain of the cases without attempting to make cultures from the glands and absolutely establishing the difference in that way. In the presence of an epidemic I do not believe it possible to afford a satisfactory legal proof that certain of the cases of glandular enlargement with fever are not mild cases of plague, although personally, as a matter of experience, I am of opinion that they are not.

6986. I want to know the grounds of your opinion?—As far as my experience of plague goes, the cases displaying a slight degree of glandular enlargement were of severe type—being septicæmic cases, and proved rapidly fatal.

6987. Suppose you see a patient only on one occasion, can you be sure it is not a case of mild plague, or is there any diagnostic symptom apart from bacteriological examination by which you can distinguish the one from the other?—In certain instances I should say not.

6988. With regard to this first dome: I do not quite understand what a dome is?—It is the name of a caste. Natives of this caste do not object to touching dead bodies.

6989. The first dome contracted plague; you say you understand he scratched his finger on the 1st of May?—Yes.

6990. What do you mean by "understanding" there?—That I did not know at the time but I was told afterwards.

6991. Does "understanding" refer to the scratching or the date?—Only to the scratching. I was told that at the *post mortem* on May 1st he scratched his finger, while removing the scull-cap.

6992. How had he been employed before the 1st of May?—He had assisted me in doing *post mortems* on other plague cases; I can give you the exact dates.

6993. Will you kindly do so?—On the 29th April he assisted me in making a *post mortem* in a case of bubonic plague. There was no suggestion that he hurt himself in any way then.

6994. Was there any other case of plague in which he assisted at the *post mortem*?—As far as I remember, he had assisted in four or five previously.

6995. A short time previously or a long time?—I can give you the exact dates; one on the 27th April and one on the 29th April as just stated.

6996. I think that is sufficient. I think you spoke of a great reduction in the number of cases of cholera?—Yes, there was a very great reduction during 1898.

6997. Which could not be entirely attributed to the exodus of the people?—No, because there was a difference in the incidence of cholera before the exodus began.

6998. Can you tell me if the number of cases of cholera does not depend very much upon the water-supply?—I believe that since the introduction of a good water-supply into Calcutta cholera has greatly decreased. Every year, however, there is a certain amount of cholera and it comes fairly regularly with reference to the seasons of the year.

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6999. Do you know if there has been any additional supply in Calcutta?—Lately, I understand.

7000. Do you know when that was?—I do not.

7001. You do not know that this coincides with the reduction in cholera?—No; there are two supplies of water in Calcutta—one filtered, and the other unfiltered. The unfiltered is used for washing streets. Whether people who get cholera have drunk the unfiltered water or not I do not know.

7002. There has been a lack of water until a short time ago, and that has been supplemented. When that insufficiency was replaced by an abundant supply then cholera diminished. Can you tell me if that coincides with the dates?—Mr. Hughes, the Engineer to the Calcutta Municipality, who is in charge of the water-supply, has kindly furnished me with the following note:—"The increase in the supply of filtered water continued up to 1892. There has been practically no increase since that date. As a matter of fact the supply in 1896-97 was slightly in excess of that in 1897-98." 1896 and 1897 were both bad cholera years.

7003. (*Dr. Ruffer.*)—With regard to *pestis ambulans*, we have it on record that numbers of those attending on plague cases have swollen glands in the axilla without being conscious of it. The Austrian Commission and the German Commission reported so. Have you searched the axilla of your nurses and your own axilla for enlarged glands?—I was very anxious about my own axilla for upwards of a week. In the *post mortem* examination of the bodies of those who have died of plague I have been obliged from the circumstances of the case to do the greater part of the work with my own hands. Several of their number having contracted plague as the result of wounds incurred in the *post mortem* examination of plague cases, the domes who are employed for work of this kind became alarmed and could only with some difficulty be induced to assist by sewing up the bodies and removing them subsequent to section. On one occasion I managed, without discovering it, to cut the epidermis of one finger, and I afterwards prepared some cultures and smear-preparations from the buboes. Then on washing my hands in a strong solution of formol I discovered the cut because it stung me. I had not discovered it before. Of course, if I had known it, I should not have gone on handling the buboes. Whether it was funk or whether I inoculated myself with a minimum dose I do not know, but I certainly had an uncomfortable feeling in the corresponding axilla for some days. It was in very hot weather, and one was naturally very uncomfortable: perhaps too I was a little below par. I have been inclined since to attribute it to funk.

7004. You got nothing more definite than funk in the nurses?—No, they never displayed fear nor complained of tender glands, and I have told you all that I have observed in my own case.

7005. (*The President.*)—Did you ascertain whether the glands were enlarged?—They were very tender.

7006. Do you know if you had any fever?—I had a bad head.

7007. You did not take your temperature?—No.

7008. Did you feel feverish?—I did: I felt uncomfortable and rather disturbed for three or four days. I ought to say that I have never seen a case of so-called *pestis ambulans*. In the 98 cases of plague which I have seen there was n doubt of the glandular enlargement in the bubonic cases, o of the severity of illness in the septicæmic and pneumoni cases. I have seen no such mild cases of plague that can b in any way compared with the cases of glandular enlargement with fever which I have referred to.

7009. Do you practise outside of the hospital?—No.

(Witness withdrew.)

LIEUTENANT-COLONEL R. C. SANDERS, I.M.S., called and examined.

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7010. (*The President.*)—You are Professor of Ophthalmic Medicine and Surgery?—Yes, of the University of Calcutta.

7011. And you attend the Mayo Native Hospital?—Yes.

7012. (*Mr. Hewett.*)—How many cases of plague were treated in the Mayo Native Hospital?—Altogether 16 patients, all died. Two others have been in the Chandni Hospital, one of which recovered.

7013. How many were males and how many females?—There were 12 males and one girl, aged five, two Muhammadans and one Hindu female. In the Chandni Hospital there was a Hindu male and a Muhammadan male.

7014. How many males altogether?—Altogether there were 16 males, I think, one Hindu female and one child.

7015. Will you give us a general description of the symptoms?—The cases were mostly of the bubonic type; all of them

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had the peculiar position of plague patients—legs flexed over the abdomen and arms flexed with thumbs much turned in. The buboes were situated in the arm-pits and groins, and in some of the cases very extensive hæmorrhages took place around the buboes, causing large blood tumours. All the cases had a marked and horribly offensive smell; I have never known or experienced anything like it before.

7016. You have been practising in Calcutta now for fourteen years?—Yes.

7017. You have been practising I suppose among all classes of natives?—Yes.

7018. Have you ever, during this period, had any experience of a type of bubonic fever in Calcutta which closely resembled plague?—None whatever; I have never seen anything like it.

7019. Have you examined the blood of the patients?—I examined the blood of some of the cases microscopically; I just made a prick in the finger and examined the blood with the microscope.

7020. The servants of the hospital were free?—Absolutely free. There was no case either in the Chandni Hospital or the Mayo Hospital.

7021. How many attendants were there?—Roughly about 18 in the Chandni Hospital and 56 in the Mayo Hospital.

7022. What did you do in the way of disinfection?—The patients were all carefully washed with perchloride solution; their clothing was put into kerosine oil and burnt. They were put in the clean bedding which was every day burnt with kerosine oil and fresh bedding was given. All sputum was passed into vessels filled with sand kept constantly wet with perchloride solution, and directly the patients died they were washed with a solution of perchloride.

7023. Have you attended any persons suffering from plague in their own houses?—I have seen one or two.

7024. What was the result?—They died.

7025. Did anybody catch the infection from those people to your knowledge?—I cannot say they did.

7026. Did you think that they were adequately segregated in their own houses?—Yes.

7027. How do you think that the plague was introduced into Calcutta?—I may be wrong, but I think the plague was introduced into Calcutta by sea. A case came into Calcutta from Bombay in 1897 and was treated in the Mayo Native Hospital. It came in the S. S. *Deepdale* and was admitted to the Mayo Hospital after being two months in Calcutta. He was very ill and had large swellings in both the parotid glands, which had been suppurating. He looked frightfully ill and was extremely anæmic, so weak that he could not walk. He told me that he had been in Calcutta two months ago. I got him segregated and looked after him very carefully. I think personally it was a case of plague.

7028. I believe you saw one of those cases in 1896?—Yes, at Howrah.

7029. You were of opinion that that was not plague?—Certainly.

7030. Was it your opinion in the middle of April 1898, when this case occurred, that plague was established in Calcutta?—After I had seen one or two cases I was satisfied that plague was established.

7031. You have served in the North-West Provinces?—Yes.

7032. Where?—In Muzaffarnagar.

7033. Have you served close to the foot of the hills of Kumaun?—Yes, in Moradabad and other places.

7034. Have you ever seen cases of mahamari in these districts?—I have seen some when I was out shooting. I had been shooting out in the villages and the natives told me not to go near certain villages because there was mahamari there.

7035. Whereabouts was this?—In the valley of the Ramganga.

7036. You have never seen it in the plains?—No.

7037. Have you heard of an authentic case in any of the plains districts in the North-West Provinces?—There was a report while I was Civil Surgeon at Moradabad, but I have never seen a case of mahamari.

7038. (*Mr. Cumine.*)—You say, I think, that the people in this country are accustomed to segregate small-pox patients in their own homes?—Yes, they put them in a room and allow only one person in the room to look after them, and when that person leaves the room he always changes his clothes.

7039. In what part of the country have you noticed this segregation?—In Calcutta and up country; in the North-West Provinces they segregate their small-pox cases very carefully.

7040. Do they do that with cholera also?—No, they do not look upon cholera as being at all infectious.

7041. Are cases of small-pox segregated by all the different communities?—The Hindus and the Muhammadans segregate small-pox cases.

7042. (*Prof. Wright.*)—When they segregate, do any of the people who attend upon the sick take small-pox; do you consider the native method of segregation an effectual way of dealing with small-pox?—The people do not look upon small-pox in this country with any fear, but they suffer very badly from it. If you notice up-country people in Calcutta, you will see they have nearly all had small-pox. They are not much vaccinated up-country.

7043. I gather that you recommend segregation in cases of plague because it is effectual in cases of small-pox?—No, my argument is that segregation and isolation are absolutely perfect theoretically, but in this country they are practically impossible. The fear of the people is so great that you drive the whole of the inhabitants away from the town and they take the disease with them, and take people who are suffering from plague with them and simply spread it all over the place.

7044. You do not think that people who attend on small-pox patients take small-pox?—I do not think so.

7045. Do the attendants take special precautions?—They are generally people who have had small-pox.

7046. (*Dr. Ruffer.*)—You say that plague patients have a marked and horribly offensive smell; is that the rule in plague?—All the cases I have seen have had this smell.

7047. Even when they had no suppurating bubo?—Even with ordinary buboes; the cases I had were of a very severe type indeed.

7048. To what do you attribute the smell?—I cannot say.

7049. Do you attribute it to the disease?—Yes. I have never smelt anything like it before; it was most offensive.

7050. Did you find any bacilli in the blood?—I did not examine it.

7051. You say the corpuscles were broken up?—Yes, I noticed them broken up in a rather peculiar way.

7052. With regard to segregation for small-pox, I do not understand how people can segregate cases in their own homes?—They put them in a room and keep them there.

7053. Do they avoid all communication with them?—They generally have one person to wait on them and they keep the door shut and simply hand things in and out. The rest of the family do not go near the room if it is in a large-sized house. I suppose at this present moment there is not a Bustee in Calcutta where there is not small-pox.

7054. With regard to the case which was admitted to the Mayo Hospital in 1897, what was his temperature? What is the usual temperature in a plague patient?—They vary. This man had been in Calcutta two months before I got him.

7055. He had only got plague lately?—No, I believe he landed with plague.

7056. Do you think the swelling was due to plague?—I should think so. He was ill for two months before I got him: the man looked so very peculiar; he was very ill when he left the hospital, but there was no swelling at all, no tenderness.

7057. Is it a common thing to see the buboes last so long?—I cannot say, I have not had a very large experience of plague; but this man came in with two enormous buboes and said he had them ever since he came to Calcutta, and that he landed with high fever.

7058. I notice the temperature was not very high in the hospital?—No, it was not.

7059. Was not his highest temperature 103·2, and did not this occur after he had been nearly one month in the hospital?—Yes, he got fever then.

7060. (*Prof. Wright.*)—Have you seen any of these cases of mahamari yourself?—No.

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7061. (*The President.*)—You do not recommend voluntary segregation for treatment of plague?—I think it is better than forcible inoculation.

7062. I understood you to say that it was entirely unsuccessful when applied to small-pox?—I do not think I said that. Small-pox may be prevalent, but they segregate cases. They have had no idea of being isolated for small-pox for many centuries past.

7063. The general method of universal segregation has not succeeded in preventing a very large amount of small-pox?—There is always small-pox in the country.

7064. Therefore it has not succeeded?—One could not expect it to succeed; they do not go in for vaccination. Some years we get it very badly—about every seven years in Calcutta. You get a lot of people, who have not been vaccinated, in respectable native houses, and they put their cases of small-pox in one room to be watched over by a person who has had small-pox and they burn the clothing afterwards. I think that is better than driving the whole of the people out of the city, as you would if you forcibly segregated them.

7065. You would hardly expect to find people who had recovered from plague in the same way?—The terror of the people of forcible segregation is so great that the women are simply almost driven mad by it.

7066. You do not put this forward as an alternative?—No.

7067. Did you attend Dr. Amulaya Churn Bose who died on the 4th September 1898?—Yes, I saw Dr. Amulaya Churn Bose on four occasions; he was suffering from pneumonia. He had no symptoms of having plague pneumonia. He was perfectly rational and could answer all questions. He was visited by a great number of people, and I am informed that no one in the house and none of the people who visited him contracted any disease. He said he had plague; he showed no signs of it. He was in a very morbid state of mind from deaths which had taken place in his family and he was related to Dr. Suresh Chunder Sircar of Barrakpur who was killed by some soldiers. This much upset him.

(Witness withdrew.)

LIEUT.-COL. G. F. A. HARRIS, I.M.S., called and examined.

Lieutenant-Colonel G. F. A. Harris.

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7068. (*The President.*)—You are Officiating Principal of the Medical College?—Yes.

7069. (*Mr. Cumine.*)—When did you take charge of the appointment?—On the 14th June 1898.

7070. Who was your predecessor?—Colonel Bomford.

7071. After you had taken charge you saw all the suspected cases shortly after admission and visited them daily and you carefully studied all cases as they came?—Yes.

7072. The total number of cases seen by you and diagnosed in consultation with Major Evans was 64?—Yes.

7073. What was the classification?—I put in a table showing that as follows:—

Bubonic cases	38
Bubonic and pneumonic	4
Bubonic and carbuncular	1
Septicæmic	12
Septicæmic and pneumonic	1
Pneumonic	8
TOTAL	64
Europeans and Eurasians	4
Hindus	39
Muhammadans	19
Chinese	1
Burmese	1
TOTAL	64

7074. How many males and females were there?—Fifty-seven were males and 7 were females. Fourteen of the bubonic cases recovered (21·8 °/o); all the rest died (71·1°/o). In 43 cases distinct enlargement of the lymphatic glands (buboes) was present. In 32 of these, the buboes were either femoral or inguinal or both combined. Only 7 cases showed axillary buboes and only 4 showed cervical buboes, one of the latter being complicated with a carbuncular swelling of the right cheek.

7075. Could you trace the method of infection?—In none of the cases seen by me could the method of infection be distinctly ascertained. None of the patients could give any trustworthy history as to how the disease could have been contracted. They generally came in too ill to give any reliable history. In one case (one of the domes employed in the Hospital Dead-house), the bubo was axillary and the possibility of *post mortem* inoculation was considered likely.

7076. I suppose that is one of the cases described by Major Evans?—Yes, he saw two. I only saw one. The other case, also a dome, was before I came—in Colonel Bomford's time. In case No. 55, a Burman, a carbuncular swelling was found on the right cheek and a cervical plague bubo. The general infection may have started from the carbuncle becoming locally infected. In case No. 74, a Chinaman, a bleb was found on the left foot which may have been the focus of general infection. As far as I am able to form an opinion on the matter, infection may take place (1) through the skin, (2) through the lungs, inhalation, and (3) through the alimentary canal. Judging by the fact that bubonic cases are most frequently seen in epidemics of plague, it seems probable that most frequently infection takes place through the skin. So far at the Medical College Hospital we have no experience of *direct* contagion, that is from the sick to the healthy, either among medical men, nurses, or sick attendants.

7077. As regards curative serum you have not had much experience?—I have had none.

7078. With regard to preventive inoculation you have not any experience?—No.

7079. Had you seen any cases of suspected plague before you came to Calcutta?—I had only seen one case of suspected plague. This was at Nagpur in January of the present year, and my diagnosis was confirmed by Col. Hutcheson, Administrative Medical Officer, Central Provinces, who had seen numerous cases of plague in the Bombay Presidency and elsewhere. The case referred to occurred in the person of a mill-hand from the Coorla Mills, Bombay, who subsequently died. In the light of my newly-acquired experience I consider this to have been a combined septicæmic and pneumonic case of plague.

7080. How many years' experience have you had in treating diseases amongst the natives, and have you ever till the present year seen any cases that might have been plague?—I have had nearly twenty years' experience in various parts of India of seeing and treating disease of all kinds (in the North-Western Provinces and Oudh, in Bengal, in the Punjab and in the Central Provinces and in Afghanistan), and to the best of my belief and knowledge I have never previous to the present year seen or treated any cases in which the clinical phenomena observed during life, and the pathological appearances seen after death, even remotely resembled the cases of plague which I have seen this year.

7081. (*Prof. Wright.*)—You have seen no cases of infection in the hospital among your nurses?—I have seen no cases of infection either amongst nurses or any other person from any living cases of plague.

7082. Is the building in which the patients are treated very open and airy?—No, it is not at all an ideal place. But it was a case of Hobson's choice, the patients came and had to be treated. It is a large fairly open room, but it is not so well ventilated as it might be.

7083. Do you take any precautions? Are the floors disinfected regularly?—The floors are washed twice a week and disinfectants are placed about, and disinfectants are put in the pans in which the patients expectorate. There is also a solution of the disinfectants for the nurses, etc., but I do not know that they are invariably used.

7084. Are antiseptics much used in your opinion?—We have them ready for use.

7085. As a matter of fact are they used much?—I do not think we use them very extensively; but we do use them. We placed the antiseptic solution in the spittoons, but the patients expectorate on the walls and the ground and all over the place, so that one really cannot disinfect the ward as well as one would like. These patients are often quite delirious and therefore do not expectorate where one wanted them to.

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7086. (*Mr. Hewett.*)—Have you formed any theory as to why plague has never become prevalent in Calcutta ?—No, I can only vaguely surmise that the climatic conditions are unfavourable. I do not see any reason why they should be. We have a damp climate, and the city is built on alluvial soil, both of which I believe are said to be favourable conditions, but there evidently is something which is unfavourable to the spread of plague ; I am not prepared to say what.

7087. Have you practised amongst the natives here ?—I see consultation cases here.

7088. Are these very numerous ?—As many as I have time for.

7089. Would it necessarily follow that a form of bubonic fever does not exist because you have not seen it ?—I do not know what is meant by a "bubonic fever" which is fatal and yet which is not plague.

7090. Might there be such a thing without your seeing it ? —It is possible—but I wish to state that I had four years' experience in the General Hospital, Calcutta, 1882-85, and I think, if such a disease existed, that I must have either seen cases myself or heard of them.

7091. Do you think that it would have come under your notice ?—I think it must have come under my notice.

7092. (*Dr. Ruffer.*)—You say that you believe that infection may take place through the alimentary canal ?—I can conceive the possibility, I am not prepared to affirm or deny it.

7093. Have you any cases showing it has actually taken place ?—No, I have seen none of the intestinal type.

7094. You think it is possible, but you have no facts bearing upon it ?—That is so.

7095. (*Mr. Hewett.*)—The Health Officer for the plague has stated that there have been several cases of plague since Calcutta was declared non-infected and that plague occurred among the patients in your hospital, is that so ?—No cases occurred among patients in the hospital, but cases of plague have been admitted into the contagious ward since the city was declared non-infected.

7096. You have no doubt they were cases of plague ?—Absolutely none.

7097. You did not see the two others which were reported ? —No, I heard of them.

7098. You had five in your hospital ?—Yes, the other two were not our cases.

7099. You have no doubt they were all cases of plague ?—Absolutely none.

(Witness withdrew.)

MAJOR R. H. CHARLES, I. M. S., called and examined.

Major R. H. Charles.

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7100. (*The President.*)—You are a member of the Indian Medical Service and Professor of Anatomy and Clinical Surgery of the Medical College at Calcutta ?—Yes.

7101. (*Prof. Wright.*)—Did you see a case of plague in Calcutta in October 1896 ?—Yes.

7102. Was that one of those cases upon which Dr. Simpson based his opinion that plague existed ?—This is one of the cases with regard to which there was a discussion with Dr. Cunningham. No one saw this case save myself, Dr. Simpson, and the medical practitioner who called me in for consultation.

7103. (*Dr. Ruffer.*)—Can you tell us the name of the case ?—The case was that of a child ; it is not in the registers at all. After having reported to the Health Officer my responsibility was legally at an end.

7104. (*Prof. Wright.*)—What made you think this was a case of plague ? Were there buboes ?—There was an axillary bubo ; the child was about 8 years of age with axillary bubo, slight cough and effusion of the eyes and a general look of being unwell. At times there was very high fever, the temperature 104, and it went down practically to just a little above normal.

7105. Why do you think it was not an ordinary case of septicæmia ?—In cases of septicæmia we generally find some mark to show the manner in which the poison has entered the blood. If this had been a case of septicæmia I should think the child would have died, but that was not the case.

7106. Have you any other point ?—It did not strike me as a case of septicæmia, forming the diagnosis from the general clinical symptoms. I cannot say why I formed the diagnosis. It was simply from my experience of plague generally.

7107. You reported the case to Dr. Simpson, and he took further steps ?—Yes, the house was disinfected and everything was cleaned down.

7108. Did he make specimens of the blood ?—Not of the blood of the child, but of the rat he did.

7109. The child's blood was not examined ?—No.

7110. The clinical information was not controlled bacteriologically ?—No.

7111. Were any rats found in association with this case ?—Yes. The rat came across, fell down, got up again, and walked along in a sort of stupid way. I got this information from Dr. Simpson. I saw the rat afterwards at the *post-mortem*.

7112. You took the cultures with you when you went to Japan ?—Dr. Simpson supplied me with a certain number of cultures which I showed to Prof. Kitasato and his assistant. Kitasato was working with reference to plague, and he examined these things, he did not know where they came from. I said that I had a specimen and I should like his opinion upon that. He did not wish to give it at first. He was very reticent, but after a considerable amount of cross-questioning I got the information I required. He gave me his positive opinion. He said that unless he did the cultures himself he would not be absolutely certain, but, morphologically, he could not distinguish the bacilli in the specimen from his own bacilli. He said that, morphologically, they were Kitasato bacilli.

7113. Do you know what these specimens were made from ? Were they made from the rat ?—Yes.

7114. Were there any other dead rats found about the place ?—I cannot say.

7115. You are of opinion that the contagion arrived on bales of goods ?—Yes, I saw the bales myself. This child was in the habit of playing about them.

7116. What were they bales of ?—I should think piece-goods covered with brown canvas cloth. I should imagine it would be cloth inside.

7117. (*The President.*)—They were not open ?—No.

7118. (*Prof. Wright.*)—Have you any evidence as to how the present epidemic broke out this year ?—As a member of the Plague Board here I knew the opinion that was formed that the rats escaped from the vessels on to the jetties and probably infected others in the house at Fairlie Place.

7119. Is that merely an opinion, or are there any facts to go upon ?—There are facts. There are the jetties, here is the house in Fairlie Place ; *this* is where the first plague case occurred in the house. Two bearers in this house died.

7120. This house is adjacent to the wharves ?—Yes.

7121. Is there any history of dead rats having occurred on the ships ?—Yes, large numbers—some hundreds of them were turned out of the godowns.

7122. I ask you if there were any dead rats found on the ships ; was there any evidence that ships came to Calcutta with dead rats on board ?—I am told so. I know that rats were cleared out of this godown after cases of plague occurred.

7123. Was this previous to the first case of plague occurring in Calcutta ?—No, I have no date of the first case. I saw the first case with regard to which there is a certain amount of discussion, the case in the Manicktolla Hospital. There was the opinion existing that it was not plague. I went to the Manicktolla Hospital and formed an opinion of that case on seeing it. I told the Inspector-General that it could be called whatever name was desirable, but that it was the same disease that existed in Bombay. The patient did not die. The discovery of dead rats, I believe, was subsequent to that, but upon that I cannot give direct evidence.

7124. You have formed an opinion that plague is excessively virulent when it is inoculated directly in the skin ?—I do that on account of the domes. I employed a certain number of domes myself in anatomical work, and my domes were very much frightened on account of the deaths which had occurred among the domes employed in the *post mortem* —five out of twelve. That is 5 men out of 12 men engaged

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in making *post mortems* contracted plague and every one of the five died.

7125. We have evidence about this already?—Yes; the reason I bring it forward is that it came under my notice. I entered into pecuniary relationship with the domes in order to keep them, because they were frightened.

7126. These domes did not die under your direct observation?—No, but I was called to see them.

7127. Do you think that a mortality of five out of twelve imports an excessive virulence in the plague?—I think if you have twelve men who have been performing *post mortem* examinations of all sorts of filthy cases for years, and who live among filthy conditions, and then five of these contract the same disease in a short space of time and that every one of these five men dies of that disease the case is a very striking one.

7128. You infer that plague was virulent because five out of twelve died?—No, but from the fact that the mortality was *cent per cent!* They are men who had been performing *post mortem* in cases of pyæmia and septicæmia and all other diseases; we had never had any deaths among them before to my recollection, but at this particular time, within a few months five out of twelve died.

7129. (*Mr. Hewett.*)—You saw the case of the child at the Manicktolla Hospital?—Yes, and the mother.

7130. Those are the two cases you have referred to?—Yes.

7131. That was in the middle of April?—Yes.

7132. And the original cases which are now said to be plague took place on the 30th of March. You see the importance of the dates, because, although the rats were dying in the middle of April, there is no proof they were dying at the end of March?—There is no statement here with reference to any dates and attention was not directed to the facts at once.

7133. But it affects your theory as to the rats having affected Fairlie Place from the ships?—Yes.

7134. It would appear now that there were cases of plague so far back as the 30th of March?—But the woman who was ill in the hospital did not live near Fairlie Place—the mother and child did not come from that part. They came from the middle of the city. This was a separate outbreak altogether.

7135. Is that a considerable distance from Fairlie Place?—Yes, and no cases between.

7136. (*Dr. Ruffer.*)—What is the date of the case in Fairlie Place?—I cannot give you the dates, but the woman that I saw was the case upon which plague was declared. It was not declared to be plague at first. The woman was in the hospital and there was doubt as to what it was.

7137. (*Mr. Hewett.*)—When you examined this woman the case in Fairlie Place had already occurred?—I cannot answer that.

7138. Have you any theory to account for the fact that plague never became very virulent here?—I should say probably at first most of the cases were got in time, they were removed, and the disease was not spread over the place all at once. Probably if there had been no segregation whatever at first we might be in trouble still.

7139. Do you think that all the cases were notified?—No, I do not, and I do not think they have all the cases now.

7140. Have you noticed that there was a great deal more plague among the males than among the females?—Yes.

7141. The number of males in Calcutta exceeds the number of females to a certain extent?—Yes.

7142. But not to the extent to which plague cases among males exceeded the plague cases among females?—No.

7143. A time came when the authorities failed to get all the cases of plague?—Yes.

7144. Why did not plague become virulent then?—Because probably the conditions for its growth were not favourable.

7145. It is rather curious, is it not, that the disease having attacked this place should not have become virulent? Would you not have expected it to be virulent here, *primâ facie*?—Plague was undoubtedly in Bombay before it became virulent; we do not know that it will not become virulent here.

7146. You mean perhaps that the outbreak has not had time to develope its full strength?—Perhaps not, I was told by doctors from Amoy and Hong Kong in Hong Kong that the same thing was observed there. You may have a little plague this year, a larger outbreak the next year, and little or nothing the following year.

7147. In other places which were attacked from Bombay there has been a sudden outbreak of great virulence and the question is whether there is any explanation as to why Calcutta has not been so affected. Look at Bangalore for instance?—The only way one can reply to that is that the conditions were more favourable for the developement of the disease in Bangalore than in Calcutta.

7148. Are there any conditions unfavourable to an epidemic of plague here which you would like to put forward?—There has been an enormous change in Calcutta with regard to sanitation of late years. Calcutta is quite different from what it was four years ago. An enormous lot has been done during the last two years. Smells are much less now; even the back galis are comparatively clean.

7149. You think then that Calcutta is better prepared to meet the epidemic than it was?—Yes, I was very favourably impressed with the improvement when I came back.

7150. Do you think those conditions have been maintained?—I think it is very much more pleasant for me to go about through the city than it used to be. I have also noticed that in very high houses the passages, the narrow stairs, and back yards are very much cleaner than they used to be. There used to be cess-pools practically all over the place. Now that is practically cleaned up.

7151. Have you attended people in their own houses?—Yes. In British Indian Street I saw two cases.

7152. Segregated in the houses?—Yes, one European and one Eurasian.

7153. Not among the native population?—No, I saw two cases in consultation; I was called in to give an opinion.

7154. Do you think that the natives segregate cases efficiently in their own houses?—To an extent they do, but not perfectly. I have seen segregation in cases of diphtheria.

7155. (*Dr. Ruffer.*)—With regard to the five domes who got plague, two have been reported by Major Evans?—Yes, and three by Major Gibbons.

7156. Have you seen any preventive inoculations performed?—Yes.

7157. Have you seen any evil results from inoculation?—No, I have seen no evil results myself.

7158. Have you seen any serious results?—No.

7159. Any abscesses?—No.

7160. What was the usual course of the temperature after inoculation?—I have only seen a few cases.

7161. Did you take the temperature?—No, the patients had little fever. I saw Surgeon-General Harvey after his inoculation.

7162. In other cases did you get a temperature of 102?—Nothing more than one could get ordinarily, 102 or 103.

7163. Did you do the inoculations yourself?—No.

7164. As you have seen Surgeon-General Harvey's case, perhaps you could tell us his symptoms?—I went to see him after he had been inoculated and I found he was a little hot. The skin was a little dry, that is, in the primary stage the same as an attack of ordinary fever which we meet with every day. He was able to talk to me for three quarters of an hour. We had a little heated discussion.

7165. How long after the inoculation was that?—Some hours.

7166. Did you take his temperature?—No.

7167. Did you see him again afterwards?—No.

7168. (*The President.*)—You have already been asked about the small number of attacks among Europeans as contrasted with natives, what do you attribute that to?—Better ventilation of houses, in the cases of the Europeans and the Eurasians. The Eurasian case which I saw did not live in very favourable circumstances. The ventilation is not so good in British Indian Street. For a European in a properly ventilated house I think there is not very much danger.

7169. Was the house in which the Eurasian lived well lighted?—No, the house was between two other high houses, and the light was not good.

(Witness withdrew.)

Dr. Frank G. Clemow.

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DR. FRANK G. CLEMOW called and examined.

7170. (*The President.*)—You are Doctor of Medicine and Diplomate of Public Health?—Yes.

7171. And District Medical Officer here?—Yes.

7172. You have had facilities for observing plague both in Calcutta and in Bombay?—Yes.

7173. What were your facilities in Bombay?—I was in charge of the Old Government House Hospital, Parel.

7174. At what time?—From the 19th February to 3rd May 1898.

7175. In that period you saw a large number of cases?—Yes.

7176. How many?—One hundred and sixty-two when I took over the hospital and 502 were subsequently admitted: 664 cases altogether.

7177. And subsequently to that time you have been in charge of the district here?—Yes.

7178. Have you any views as to the origin of plague in Calcutta?—I have some notes as to the possibility of its introduction either by rail or by sea. I made enquiries. The result of my enquiries as to the possible entry by rail was negative. I also made enquiries as to the possibility of its coming by sea, but there is no evidence of plague having occurred on any ship coming from an infected port to Calcutta.

7179. With regard to the manner in which the disease is communicated, what have you to suggest about that, judging from your experience in Bombay and Calcutta?—There is evidence to show that insanitary conditions favour the spread of plague.

7180. On what grounds do you say that?—That the majority of cases in Calcutta were among the poorer classes of natives living in dirty and unhygienic places, that the early cases occurred in an insanitary area, and in houses and bustees which abound in sanitary deficiencies. The outbreak in Roop Chand Roy's Street—the most concentrated outbreak in Calcutta—occurred in one of the most insanitary bustees. The large majority of the cases in Parel Hospital were of the poorest classes, whose dirty bodily state showed that they lived among insanitary conditions.

7181. Have you made any enquiries as to the association of plague with any special conditions in Calcutta?—Yes. I ascertained with regard to an establishment at the corner of Fairlie Place—which I was requested not to name—where dead rats were found at the beginning of the epidemic, that there has been absolutely no recurrence of the rat mortality, that the rat mortality had never appeared before, and that the discovery of these rats at that time was a very exceptional occurrence.

7182. (*Prof. Wright.*)—Were there any human cases there?—Yes; I was informed that at least nine of the employés had sickened from plague at the same time as the rat mortality had occurred, and that the disease among the employés disappeared after disinfection of the premises and after the employés were supplied with boots; the employés had hitherto been bare-footed.

7183. (*The President.*)—Did the plague cases occur before or after the rat mortality?—I do not know.

7184. Can you tell me if the result of your enquiries has given you any evidence that the death of rats always precedes the outbreak or the occurrence of plague?—No, I have no personal experience of that at all. My experience would point to the fact that sickness and death of rats occur at the same time as the cases among human beings. I have had no experience of its occurring before cases in human beings, but they have occurred at the same time, and in several houses in Calcutta sickness and deaths from plague were associated with unusual mortality among rats in those houses.

7185. So far as you have been able to discover, the rats have not produced the disease?—The evidence I have on the subject is inconclusive. Perhaps the most remarkable instances of association of rat mortality with human plague cases were those in British Indian Street. A native died on June 15th in premises in British Indian Street. I saw the body at 7 a.m., four hours after death, and I succeeded in isolating plague bacilli from the bubo. The *post mortem* signs were those of plague. One big toe had been partially eaten away by rats. Subsequently three dead rats were found in the same godown where the man had died, and dead and dying rats were found in the adjoining premises during the next week or two.

7186. There is no evidence there that the rats produced the disease in the house in which the man died from plague?—Yes there is evidence the other way—that the man produced the disease in the rats.

7187. Have you any instance of mortality among rats preceding the occurrence of plague in human subjects?—Yes, in the adjoining house in the same street. Rats were found in the intervening two weeks and this patient sickened on June 30th, 15 days after the first case. He stated that two or three weeks before his dog had brought a dead rat and placed it on his bed. A day or two after, the dog was taken ill but recovered. The patient touched the rat in moving it from the bed.

7188. Have you any other case of a similar kind?—Seven days later in the same street, four doors from the preceding case and three doors from the first case, an Eurasian female was attacked with plague. Dead rats had been found in this house and in the house on the other side. So that in this street five out of six houses gave a history of mortality from rats, and in three of these houses cases of plague occurred. Of 32 cases of plague in Calcutta investigated by myself, I found positive evidence of the occurrence of dead or sick rats in seven. In the remainder there was either no evidence on the point to be obtained, or the evidence that could be obtained was either negative or untrustworthy.

7189. Have you made any enquiries regarding the communication of plague from one person to another?—I have evidence on the possible means by which plague may pass from one person to another. In the living patient I have in a large number of instances isolated a bacillus identical with that first described by Kitasato, from the following sources: (1) The fresh juice of a bubo, before suppuration has commenced; (2) from the blood stream (by pricking the finger) at least three hours before death; (3) from the sputum of pneumonic patients; and (4) from the urine. I have never succeeded in obtaining it from the pus of a discharging bubo. I have never examined the fæces for its presence, but other observers have found it in them. In plague cadavers I have isolated the organism from (1) the bubo; (2) the spleen; (3) the liver; and (4) the lungs.

7190. (*Dr. Ruffer.*)—In the second instance you mention was the diagnosis made by microscopic or by bacteriological examination?—By both.

7191. You found bacilli in certain plague patients?—Yes.

7192. What was the character of the sputum in pneumonic cases?—With regard to the sputum in pneumonic cases it was very often the characteristic pneumonia sputum; it seemed to me to show in many cases but little difference from ordinary pneumonic sputum. I am speaking now of what happened nine months ago, and my remembrance of it is that it was a reddish-brown tenacious sputum, some times tinged with fresh blood.

7193. (*The President.*)—It was not at all watery, I suppose?—In some cases it was certainly thin and watery, but not in all.

7194. To all intents and purposes it was the sputum of ordinary pneumonia?—Yes in some cases, while in others it was more watery than ordinary pneumonic sputum.

7195. You found bacilli in the sputum?—Yes.

7196. Can you tell me at what period in the illness you found them?—Within a few hours before death, and several days before death also. In the majority of cases it was almost impossible to get the history of previous duration of the illness before admission.

7197. Do you think you found them more than two days before the death of the patient?—Speaking entirely from memory I should say yes.

7198. With regard to urine?—I found the bacillus in two cases. I found conclusive evidence that in one case it was the plague bacillus. The urine examined under the microscope was swarming with a bacillus which on staining gave the morphological appearances of the plague bacillus. I sent some of the urine to Haffkine's laboratory in Bombay and was informed that pure cultures of the plague bacilli had been obtained from the urine. In the second case the urine was practically identical in appearance. I sent a bottle of the urine to Haffkine's laboratory, but unfortunately it never reached the laboratory.

7199. In the first case in which the bacillus was discovered at what stage was it taken from the patient?—It was in the late stages.

7200. The patient died shortly afterwards, I believe?—The same day, I think.

7201. Have you this case?—I have notes of it.

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7202. Have you a note as to the hour and the date on which the urine was taken from the patient?—The case was that of a Hindu male aged 19 who was admitted at 8·35 a.m., on 11th April. He died at 8 p.m. the same day.

7203. The urine was taken before death?—Yes, and probably within eight hours before death.

7204. Are there any other cases in which you looked for the bacillus?—In a large number of cases.

7205. In what parts of the body?—In the bubo, the blood stream and the urine.

7206. What was the result in regard to the urine?—Only in those two cases did I find evidence of the presence of the bacillus in the urine.

7207. How often did you look for it?—Some twenty or thirty times.

7208. And always shortly before death?—I think probably so, because the average length of time in which the patients were in the hospital was very short.

7209. Have you looked for bacilli in any other places?—I have looked for them in the pus of a discharging bubo, and in some of the other local lesions in plague, such as furuncles and necrosed patches of skin, but I never succeeded in finding them. I have not examined the fæces.

7210. Have you made any observations regarding the manner in which the virus of plague gains access to the body?—I have; I have evidence on the mode of the possible entry into the body.

7211. What are the results of your observations?—Perhaps I should best summarise by saying that I think the possible modes of entrance are the following:—

1. The skin, probably through abrasions or scratches; possibly through the unbroken skin. That this channel is a frequent one is *à priori* probable. It is, however, in my experience rarely, if ever, possible to find with certainty the precise point at which the organism entered. Even when the site of inoculation is known, as in those cases where plague has been contracted through a *post-mortem* wound, it will be found that the wound or scratch itself rapidly heals and may become invisible before death. Some caution, too, is required in accepting the mere presence of a cut or scratch on the same side as the bubo as pointing to the site of entrance of the poison; and I have notes of two cases in which a wound was found in the limb of one side, while the bubo was on the opposite side (groin in one case and axilla in the other)—the limb of that side showing no discontinuity of skin that could be discovered.

2. The conjunctiva. An English nurse contracted plague in the Parel Hospital in the following manner: a minute portion of the sputum of a plague patient in the act of expectoration entered the conjunctival sac of one of the nurse's eyes. Notwithstanding immediate resort to irrigation and antiseptics, a slight conjunctival injection developed, followed by the appearance of an enlarged gland just below the ear of the same side, and death occurred on the 7th day.

3. The respiratory tract. It would appear *à priori* probable that the pneumonic form of plague is contracted through the respiratory tract. Whether, however, the organism gains access to the lungs by being inhaled, and passing directly through the unbroken epithelial lining of the air cells, or whether it gains access to the lymph-stream through abrasions in the mouth, pharynx, larynx or trachea and shows a selective action on the lungs appears to me to be undetermined. I have not seen any instances in which it could be shewn that pneumonic plague resulted from inhaling the breath of another pneumonic plague patient. Of the members of the staff of the Parel Hospital who contracted plague not one contracted the pneumonic form.

4. The alimentary canal. I have no evidence pointing to the possibility of plague being contracted through eating infected articles of food, but it seems *à priori* probable that this may occur.

7212. (*Dr. Ruffer.*)—Was the case of the nurse mentioned in your ward?—It was when Dr. Castelotte had charge of the hospital. I am afraid he has left. He is now on an expedition in Central Africa.

7213. Did you note how long it was before the patient took ill?—I believe on the third day.

7214. Have you any record in the hospital?—The hospital is absolutely closed. The records which remain would be in the hands of the Plague Commission in Bombay.

7215. Will you give us the names and dates?—Yes. Captain Jennings, I.M.S., who was living at Parel at the time, has kindly furnished me with the following additional notes in regard to this case:—Tuesday, February 15th, was the date on which the patient's sputum accidentally entered the nurse's eye. The eye smarted and felt sore up till Friday the 18th, and then there was feverishness and tenderness below the ear on the side of the affected eye. On Saturday the 19th, plague symptoms were marked, and on Sunday and Monday she was in a state of coma vigil. On Monday evening she recognized a friend's voice, and told the friend that she had plague and that it was horrid. She became unconscious on Monday night; the pulse was thready and running. All Tuesday she was lying unconscious, and with Cheyne-Stokes breathing. She died on Tuesday evening, February 22nd.

7216. Have you any other illustrations?—No.

7217. Have you some examples of the spread of the plague to persons occupied in carrying out the plague measures?—Yes, I have 9 cases.

7218. Will you kindly state the facts?—The following cases came under my own observation and treatment in the Parel Hospital, Bombay:—

Hospital Assistant. Æt. 30. Hindu, male. He made a *post mortem* examination on March 14th at 3 p.m. on the body of a patient who had died of pneumonic plague thirteen hours before. During the examination he pricked one of the fingers of his left hand. On the evening of the 16th he felt ill. He was reported sick on the 18th and had then high fever with enlargement of the left supratrochlear gland. On March 19th there was a bubo in the left axilla, and he died on the morning of March 20th.

7219. Was that Hospital Assistant in charge of the plague patients or not?—The duties of the Hospital Assistant were to carry out my orders generally, to take the history of freshly admitted patients, to administer hypodermic injections, and carry on the dressings of the plague patients. The second case was that of an ayah employed in the female wards, æt. 25, Hindu, female. She developed symptoms of plague on March 12th, had right axillary, right cervical submental and right and left inguinal buboes, which did not suppurate. Death occurred on the 17th.

The other cases were the following:—

(3) Mehtar, or sweeper, employed in the male wards, æt. 17, Hindu, male, was attacked on March 17th and admitted as an in-patient on the 18th. He had a right inguinal bubo and died on the 22nd. This patient had had a previous attack of plague, while similarly employed in the previous December.

(4) Ward boy employed in the male wards, æt. 20, Hindu, male. The date of onset was April 14th. He had a left inguinal bubo which suppurated. He recovered.

(5) Gardener, employed in the compound of the hospitals. Æt. 26, Hindu, male. Admitted April 5th on the third day of the disease. There was a left femoral bubo and he died on the 8th.

(6) Limewasher. Æt. 22, Hindu, male. Employed by the Plague Commission to limewash evacuated houses where plague had occurred. Attacked March 2nd, admitted the 5th, with a right femoral bubo. He died on the 6th.

(7) Limewasher. Æt. 45, Hindu, male. Attacked March 2nd, admitted March 5th, with right cervical bubo, died March 7th.

(8) Limewasher. Æt. 25, Hindu, male. Attacked March 15th, admitted the 17th with left femoral bubo and died four hours after admission.

(9) Tile-turner employed to turn the tiles of evacuated houses. Attacked March 3rd and admitted the 5th with right inguinal bubo. He recovered. There was a wound on the left shin, though the bubo was on the right side.

In regard to the source of infection in the above cases, I should be loth to assert that they all contracted plague solely as the result of their special exposure to risk in the course of their duties. In the case of the hospital assistant, however, it was certainly so, while in those of the ayah, ward-boy and sweeper at work in the wards it was exceedingly probable that that was the cause of their illness. But even in these cases, as also in those of the gardener, limewasher and tile-turner, it is to be noted that they all spent one-half of the 24 hours at their own houses in different parts of the city of Bombay, that these portions of the city were infected, and that there is nothing to show that these persons did not contract the disease in the same way as other natives not employed on plague work.

The following cases of plague among members of plague staffs did not come under my own observation, but

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have been gathered from various sources. The list does not claim to be in any way a complete one. The cases have been entered in my note-book as they came under my notice, whether in newspaper records or in various plague reports:—

Fourteen medical men or women, of whom nine died.
Eight nurses, of whom seven died.
Five Hospital Assistants, of whom at least two died.
One medical student, who died.
Five domes, all of whom died.
Thirteen (or fourteen) coolies in disinfecting gangs of whom at least eight died.
Three ward orderlies, all of whom died.
One sweeper on hospital duty, who died.
One laboratory assistant, who died.
Seven police on plague duty, all of whom died.

The total number of such cases therefore of which I have record, including the cases observed by myself, is 67 (or 68); and of these at least 51 died. The list, though in the absence of statistics as to the numbers employed on plague work it does not definitely determine the amount of risk plague-workers run, demonstrates conclusively that the risk is an appreciable one.

7220. Can you put in a statement giving details of those cases?—Certainly, it is as follows:—

A.—Medical men and women.

1. Dr. Godinho of the Jamsetjee Jeejeebhoy Hospital, Bombay, died from plague on March 23rd, 1897.

2. Surgeon-Major Manser, died of pneumonic plague in Bombay on January 6th, 1898.

3. One medical officer died of plague in the Dariastan Lohana Hospital, Bombay. (General Gatacre's report,* page 112).

4. Dr. (Miss) Phillips died of plague in Bombay on August 27th, 1898.

5 and 6. Two medical officers in the Mahratta Hospital, Bombay, were attacked with plague in September (or October) 1898 and one died. (*The Lancet*, October 29th, 1898).

7. Mr. Hankin was attacked with plague in March 1897. (*The Lancet.*)

8. Captain Leumann, I.M.S., was attacked with plague in Bangalore. (Evidence before the Indian Plague Commission).

9, 10 and 11. In Hong Kong three Japanese physicians contracted plague in 1894 and one died.

12. In October 1898, Dr. Müller of Vienna, died of plague contracted in attending on plague patients.

13. In December 1898, Miss Game, Assistant Surgeon to the Female Jubilee Hospital, Lahore, was attacked with plague. (*The Englishman*, December 27th, 1898).

14. Dr. Desai in charge of the Hindu Hospital, Bombay, died of plague in 1897. (General Gatacre's report,* page 233).

B.—Nurses.

15. On February 14th, 1898, Miss Morgan, nurse at the General Hospital, Singaun, Poona, died of plague.

16. On February 22nd, 1898, Miss Macdougall, nurse at the Parel Old Government House Hospital, died of plague.

17. In 1896 Sister Elizabeth of the Bandra Convent, died of plague in the Mahim Causeway Hospital. (General Gatacre's report,* page 41).

18. At Cutch Mandvi Nurse Home died of plague. (*Ibid*,* page 233).

19—20. In Hong Kong two Eurasian sisters of the Italian Convent were attacked with plague and one died in 1894. (*The Lancet*).

21. A third sister who nursed one of the above also died in Hong Kong. (*Ibid.*)

22. Nurse Pecha died of plague in Vienna in October 1898. (*The Lancet*, October 29th, 1898).

C.—Hospital Assistants.

23. Shaik Abdul Rahman died at the Jamsetjee Bandar Hospital, Bombay, on April 7th, 1897. He was thought to have caught the disease through using a patient's soap. (General Gatacre's report,* page 29).

24—25. On March 24th, 1897, two Hospital Assistants were attacked with plague in the Adamjee Peerbhoy Hospital, Bombay. (*Ibid*,* page 122).

26. One hospital assistant was attacked in the Mahim Hospital, Bombay. He recovered. (*Ibid*,* page 233).

27. In January 1898 a Hospital Assistant in Hardwar contracted plague through a *post-mortem* wound. (*The Englishman*, January 27th, 1898).

D.—Domes,

(or natives of low caste employed to assist in the mechanical part of *post mortem* examinations).

28. Sukku, a dome, was wounded in making a *post mortem* examination in the Campbell Hospital, Calcutta, on June 3rd, 1898. He sickened on June 6th and died on the 10th. (*The Indian Medical Gazette*, August 1898).

29. One dome who assisted in the autopsy on the first recognised case of plague in Calcutta, contracted plague through a wound at the time of the autopsy, and died.

30—32. Three other domes contracted plague in Calcutta in a similar manner, and all died.

E.—Ward orderlies.

33. In the Grant Road Hospital in Bombay a ward orderly died of plague; he was thought to have contracted it by drinking the remains of stimulants left in patients' drinking cups. (General Gatacre's report,* page 94).

34—35. The same report speaks of two other cases of plague in ward orderlies or three in all. (*Ibid*,* page 233).

F.—Persons employed in disinfecting work.

36—48 (or 49). Two coolies employed in disinfecting gangs in Kariam (Jullundur district of the Punjab), were attacked with plague. (*The Englishman*, November 2nd, 1898).

Five coolies in gangs sent from Bombay to Cutch Mandvi in 1897, died while there; and three others after their return to Bombay. (General Gatacre's report,* page 233).

Three or four coolies employed in disinfecting houses were attacked in Bombay in 1897 (*Ibid.**)

G.—Policemen on plague duty.

49—55. Seven policemen on plague duty in the Punjab were reported as dying from plague in May 1898. (*The Englishman*, May 28th, 1898).

H.—Other persons.

56. One medical student was attacked and died in Calcutta in April 1898.

57. One sweeper employed in the Parel Hospital, who was "constantly occupied in the *post-mortem* room," had a mild attack of plague in 1897. (General Gatacre's report,* page 51).

58. One laboratory assistant contracted plague in Vienna in October 1898, and died on October 18th. (*The Lancet*, October 29th, 1898).

The total number of cases is therefore either 58 or 59 (depending on whether three or four coolies were attacked in Bombay). If to these be added the 9 cases described in my evidence, the total is either 67 or 68; and of these at least 51 died.

7221. Have you any other point you would like to speak upon?—I have tables showing age, sex, religion or caste, incidence in 502 cases of plague, as follows:—

Of 502 cases admitted to the Parel Hospital while I was in charge of it 407 were fatal. The mortality was 81·07 per cent. If 82 cases be excluded which died within 12 hours

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* Report on the Bubonic Plague in Bombay, by Brig. General W. F. Gatacre, C.B., D.S.O., Chairman, Plague Committee, 1896-97.

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after admission or were admitted dead, the mortality sinks to 75 per cent. These were distributed as follows:—

Sex distribution.—Males 331 cases, or 66 per cent. of the total.

Females 171 cases, or 34 per cent. of the total.

Sex mortality.—This in males was 81·3 per cent and in females 80 per cent.

Distribution and Mortality by Ages.

	0—	5—	10—	15—	20—	25—	30—	35—	45—	55—	65+	Unknown.	Total.
Total cases	13	26	47	65	85	78	76	64	34	10	3	1	502
Deaths	10	17	33	50	65	64	64	56	31	10	3	1	407
% Mortality . . .	77	65·4	70·2	80·1	76·5	82	84·2	87·5	91·2	100	100	...	81·07
% of cases to total cases .	2·6	5·2	9·36	13	17	15·5	15·1	12·7	6·7	2	·6	·2	100

It will be observed that the majority of cases (over 60 per cent.) occurred between the ages of 15 and 35. The information obtainable as to the age of patients was as a rule most unreliable, and only approximate in almost every case. The mortality was 77 per cent. in children under 5; sank to 65·4 per cent. between 5 and 10; was rather higher (70·2) between 10 and 15; and rose almost to the average for all ages at 15—20. After a slight drop again (to 76·5) between 20 and 25; the mortality steadily rose at succeeding groups of ages until above 45, only 8·8 per cent. of the cases recovered, while above 55 every case proved fatal.

Incidence and mortality by religions.

RELIGION.	MALES.			FEMALES.			TOTAL.		
	Cases.	Deaths.	% M.	Cases.	Deaths.	% M.	Cases.	Deaths.	% M.
Hindus .	267	220	83·5	139	109	80	403	229	81·4
Christians .	56	44	78·6	29	23	79·6	85	67	78·8
Muhammadans	7	5	71·4	6	5	83·3	13	10	77
Parsee . .	1	1	...	...	...	...	1	1	...

By far the largest number of cases were lower class Hindu natives. The mortality was highest amongst the Hindus and lowest among the Muhammadans, the Christians (mostly Goanese or Eurasians) occupying an intermediate place.

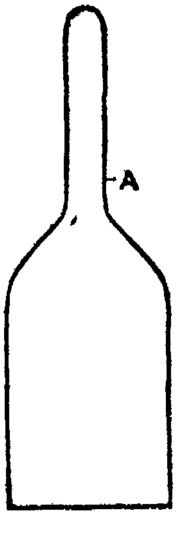
7222. You have had any experience of the effect of curative serum; you have seen 50 cases?—Yes, the cases were treated with Yersin's serum.

7223. Could you tell us the general result of that treatment?—I am sorry to say it was quite negative.

7224. Have you the facts?—Yes; in March and April 1898, 50 cases of plague under my care were treated by the injection of a serum prepared by Yersin's method in the Imperial Institute of Experimental Medicine in St. Petersburg, and brought to India by the Russian Plague Commission of which Dr. Yassenski was the principal member. The cases for inoculation were not selected in any way. Every alternate case of true plague admitted, provided the diagnosis was certain and the patient was not moribund, was submitted to the treatment. The other alternate cases were noted as control cases. At first 20 c. c. of the serum were injected in the flank once daily. After the first three or four cases a second dose of 10 c. c. was given in addition in the evening. Later these doses were increased to 30 and even 40 c. c. in the morning and 20 c. c. at night; the highest doses being therefore 60 c. c. in a day. The treatment was continued for periods varying from two to ten days. The injected patients received in addition the ordinary medicinal and other treatment, to which the control patients were submitted. The 50 patients received in all 5,820 c. c. of serum, or rather over 116 c. c. per head. Those who recovered received an average of 175 c. c. each, and those who died nearly 102 c. c. The difference was due solely to the fact that the treatment could be continued longer in those who recovered than in those who died. In each group—inoculated persons and controls,—40 of the cases died and 10 recovered; the mortality in each group was 80 per cent.

7225. Had you any experience of the method of preparing the serum?—I obtained detailed information on the point from Dr. Yassenski.

7226. You had written information?—Yes, and also a printed pamphlet which gives full details of the method adopted in the Imperial Institute of Experimental Medicine in St. Petersburg. The way it was stored seemed quite the best that I have seen. The serum is put up in 10 c. c. doses in small glass flasks, drawn out to a long neck. The neck is sealed in the blow flame, and no cork or sealing wax is required. The method appears to me preferable to any that I have yet seen. The serum prepared in the Pasteur Institute in Paris is put up in small bottles closed with a cork and sealing wax, and a similar method is employed for the storage of M. Haffkine's prophylactic. The latter has the still further disadvantage that the fluid is put up in quantities sufficient for some thirty or forty persons, and that if only one or two persons are to be inoculated the greater part of a bottle may be wasted. The flasks used for the Russian serum were of the shape and approximately the size of the sketch attached. An assistant prepares them for the inoculator's use by filing the neck near the junction of the neck with the body (at A). A very rapid and superficial mark with the file is enough to enable the inoculator to break off the neck at the moment he requires to use the serum. The fluid being already in measured doses of 10 c. c. each, he has no need to measure the quantity taken up in the syringe, if a multiple of 10 is to be the quantity injected. The flasks are packed in separate little wooden boxes of thin bits of wood lightly nailed together, and lined with cottonwool. They can be subjected to comparatively rough usage with little fear of injury to the flask inside.



7227. Was 60 c. c. the dose recommended?—The Russian Commission themselves were feeling their way with the serum, that is why they began with 20 c. c. and gradually increased it.

7228. 40 c. c. was the largest single dose?—Yes.

7229. And 60 c. c. was the largest per day?—Yes.

7230. And the results were entirely nil?—Yes.

7231. Were any of the clinical features of the disease altered?—There was never any local reaction at the site of injection. The fluid was rapidly absorbed in every instance. The injections gave rise to no characteristic symptoms. Their effect on the plague symptoms was practically nil. A fall of temperature occasionally followed the injections, but falls of temperature are not uncommon in plague without

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any special form of treatment. Albuminuria was present in 21 cases, of whom 18 died; it was not in any way affected by the injections. Delirium was present in 28 cases, and other nervous symptoms, such as drowsiness, thick and halting speech, coma, etc., in almost every case. These symptoms were also unaffected by the injections. Vomiting was a symptom in six cases and in two it was very severe and almost uncontrollable, it was not checked or increased by the injections. Hiccough occurred in two cases, both fatal; and general convulsions in two other cases, also fatal. The spasm did not appear to be brought on by the injections, and in one instance convulsions had occurred before the injections were begun. Pneumonia occurred in two fatal cases, and a small pneumonic patch developed in a third, which recovered. Diarrhœa occurred in six fatal cases and in one which recovered. No connection could be traced between it and the injections. With regard to the effect on the buboes, suppuration occurred in seven out of the ten cases which recovered and in none of those which ended in death. The percentage of suppuration in non-fatal cases was therefore 70 per cent. On the other hand, out of the total of 502 cases admitted to the Parel Hospital 85 cases with buboes recovered, and in 52 of those suppuration occurred; that is to say in 61 per cent. Suppuration therefore was slightly more common in the inoculated cases than in others, but the figures appear to be too small for much weight to attach to them.

7232. Will you give us the results and mortality?—Yes. The mortality in each group of 50 cases, inoculated and control, was exactly the same. In each group 40 patients died and 10 recovered. The mortality in each group was 80 per cent.

Death occurred in 7 on the 1st day after commencement of treatment.

Death occurred in 15 on the 2nd day after commencement of treatment.

Death occurred in 10 on the 3rd day after commencement of treatment.

Death occurred in 1 on the 4th day after commencement of treatment.

Death occurred in 3 on the 5th day after commencement of treatment.

Death occurred in 1 on the 6th day after commencement of treatment.

Death occurred in 1 on the 9th day after commencement of treatment.

Death occurred in 1 on the 10th day after commencement of treatment.

Death occurred in 1 on the 11th day after commencement of treatment.

The days were reckoned, not by dates of the month, but by periods of 24 hours from the hour of the first injection.

With regard to the effect upon the results of the period of the illness at which the injections were begun, I have the following figures:—

	No. of cases.	Of which died.	Percentage mortality.
Injections begun on the 1st day .	6	6	100
,, ,, ,, 2nd ,, .	13	9	69·2
,, ,, ,, 3rd ,, .	10	8	80
,, ,, ,, 4th ,, .	7	6	85·7
,, ,, ,, 5th ,, .	6	6	100
,, ,, ,, 6th ,, .	1	1	100
,, ,, ,, 7th ,, .	2	1	50
,, ,, ,, 8th ,, .	1	...	...
,, ,, ,, 10th ,, .	1	...	...
,, ,, ,, Unknown .	3	3	100

The information obtainable upon the previous duration of the disease was frequently untrustworthy, and the figures here given are therefore only approximate. But of the six cases in which the treatment had begun on the first day, the history was apparently fairly reliable, the hour of onset being definitely ascertainable in some. Of these six, however, all without exception died. Of 13 in whom the treatment was begun on the second day, 9 died, or 69·2 per cent., and of 10 on the third day, 8 died, or 80 per cent. It is noteworthy that two cases, in whom it began on the 8th and 10th days respectively both recovered. (Nos. 901 and 952). Urticaria developed in one case which recovered. The patient (No. 836) a Christian male, æt. 19, was admitted on March 11th, 1898, the serum treatment was commenced on the 12th and he received 50 c.c. each day until the 16th when he only received 30, and on the 17th he received 20c.c., and on the 18th a final dose of 40cc. In all he had received 290 c.c. of the serum. The urticaria appeared on the 19th, the day after the last injection. It appeared as a scattered rash over the thorax only and disappeared on the following day. Carbolic staining of urine occurred in one case (No. 901). The serum contains 0·5 per cent. of carbolic acid in order to preserve it. The patient had received 60 c.c. serum on March 18th and 40cc. on the 19th, or 100 c.c. in all. This was equivalent to 0·5 c.c. of carbolic acid. The urine became dark on the 20th, was still slightly stained on the 21st, but became normal on the 22nd, when 40 c.c. were again administered, but the urine did not again become stained. On March 25th one injection of 20 c.c. was again followed by discoloration of the urine. There was no albumen or blood in the urine. The patient had three ulcers and some furuncles on the legs, but these had developed before the treatment began. He made a good recovery. Panophthalmitis developed in two cases, both of which died. In both the condition had commenced before the injections were begun. The injections did not in any way affect the process, the eye becoming completely disorganised in each case. Erysipelas unfortunately caused the death of two patients. It was not the result of the injections, as in neither did it commence round the site of an inoculation: in one occurring over the bubo and down the thigh (No. 904), and in the other developing on the abdomen round a furuncle (No. 927). At attack of cystitis complicated one case.

7233. I think you have also tried some other serum?—In the month of April, 13 patients under my care in Parel Hospital were submitted to injections of a serum prepared by Prof. Lustig, and brought to India by Drs. Galeotti and Polverini who administered the injections. The majority received one injection of 15 c.c. once daily, occasionally the dose was 20 c.c., and in a few patients two doses of 15 c.c. each were given in one day. The total received by any one patient varied from 15 c.c. to 95 c.c. In some cases a fall of temperature followed the injections, but the fall was generally followed by a subsequent rise. No other effect on the symptoms of plague could be observed. Albuminuria was present in 8 of the 13 cases and of these 5 died. The symptoms did not appear to be in any way affected by the injections. Ten of the 13 cases so treated died. The mortality was therefore 77 per cent. Ten of the cases were males, and of these 8 died (80 per cent.); three were females, of whom two died. The figures appear to me too small to lead to any final conclusion, but so far as they go they lend no support to the claims of the serum as a curative. It is right to add that Drs. Galeotti and Polverini stated that they had obtained much more promising results elsewhere.

7234. Have you had experience of preventive inoculation?—I have not performed any inoculations myself.

7235. Have you seen cases of plague in persons who were previously inoculated?—Yes.

7236. Will you give us the details of these cases?—The following three cases of plague, in persons who had been inoculated with M. Haffkine's prophylactic came under my observation:—

Case I.—Register No. 715, Hindu, male, æt. 22. An ex-convict in H. M. Common Prison, Bombay, admitted to Parel Hospital, February 28th, 1898, with a history of 24 hours' illness. He had been inoculated on January 1st and January 4th while in prison. His state on admission was as follows: Temperature 101·8, pulse 112, respiration 36, tongue lightly coated. There was a large diffuse swelling of both sides of the neck, more prominent on the left. On the following day the temperature rose to 102·8, it then fell to normal and did not rise again. Convalescence was uninterrupted and he was discharged on April 4th.

Case II.—Register No. 906. Hindu, male, æt. 17. Convict in H. M. Common Prison. Admitted to the Parel Hospital, March 18th, 1898, with a history of four days' illness. He had been inoculated on January 1st and January 4th. He was sentenced to six months' imprisonment in September 1897, and had never been out of prison subsequently. His state on admission was as follows: Temperature 100·4, pulse 120, respiration 32. There are large diffuse swellings on both sides of the face, exactly as in the previous case. The parotid, submaxillary, and submental glands are all enlarged. The tongue is lightly furred, the eyes slightly injected, the spleen is not enlarged, the mental state and speech are normal, and the bowels regular. On the following day the temperature fell to 95·4, and after regaining the normal never rose above it. He was discharged cured on April 4th.

These two cases closely resembled each other in history and in the symptoms. There was much in the latter which recalled the clinical picture of mumps. From correspondence with the Medical Officer to H. M. Prison, I

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ascertained that only one case of mumps had occurred in the prison during the preceding eight years, and that "singularly enough it occurred just when two cases of plague died in Jail. Was it mumps?" he asks, and adds, "I have at present (26th March) in Jail a case that seems to be mumps, but all the glands in the neighbourhood of the maxilla, sub-lingual, sub-maxillary, sub-mental are enlarged as well as the parotids, giving a curious oval rotundity to the lower segment of the facies. There is no fever, but I am doubtful whether it is pure mumps." I am inclined to regard these three cases as cases of modified plague in inoculated subjects, analogous to cases of modified small-pox in vaccinated persons. The second case had not at any time been in contact with the first.

Case III.—Register No. 915. Hindu, male, æt. 16. Admitted to Parel Hospital, March 19th, 1898. No history of the illness could be obtained, as the patient was unconscious; but it was ascertained that he had been inoculated only two days previously (March 17) at the Veterinary College Inoculating Station. The case was a severe one from the beginning. The temperature was 104·4°; the pulse 144, and respiration 40; the tongue was characteristic, the conjunctivæ markedly injected, there was marked delirium; in the left groin was a large, tender, diffuse bubo. He was unable to take food and had to be fed per rectum. In the evening he was very violent, hypodermic injections of morphia were given, and sulfonal gr. xv administered, in addition to the routine medicinal treatment. The temperature fell in the evening to 101·2°. On the 20th he received an injection of 40 c.c. of Yersin serum, and a second dose of 20 c.c. in the evening. He was very weak; pulse and respiration were very rapid and weak. On the 21st he was drowsy and slept much. The tongue was dry and brown in the centre, with white fur on either side and pink edges. The pulse was 144 and rather stronger; respiration 22 and deeper than yesterday. Loud snoring rhonchi are heard on both sides of the chest. He is still fed per rectum. The urine could not be obtained for examination. He died at 7 A. M. on the 22nd, on the third day after admission, and the fifth day after inoculation. The history of this case appears to point to the conclusion that the disease was either already incubating or already developed when he was inoculated with the prophylactic on March 17th, and that the inoculation did not influence the course in any way.

7237. You have suggested that the two first cases have a resemblance to mumps?—Yes.

7238. Did you take pains to distinguish them from mumps?—Yes, my opinion was that they were modified cases of plague and not mumps.

7239. Was any bacteriological examination made?—I did in the second case obtain a few drops of fluid from the glandular swellings by a hypodermic syringe, and endeavoured to obtain the bacilli but I found none. The bacteriological evidence was negative.

7240. (*Prof. Wright.*)—Did you get any fluid off?—Yes, in the syringe, I should have stated I made microscopical examination. I did not make cultivations.

7241. (*Mr. Hewett.*)—Do you think that plague is essentially a filth disease?—Not essentially, I think filth conditions favour plague.

7242. Have you any theory to account for the fact that the outbreak in Calcutta has never been very virulent? Why did it not get as virulent as in Bombay?—I have endeavoured to discover some difference in conditions to account for this but have not succeeded. Calcutta is every whit as insanitary as Bombay.

7243. Have you any record as to the spread of plague by human communication?—Yes. In a certain number of instances the diffusion of plague in Calcutta could be definitely traced to the movements of persons, either themselves infected or having been in contact with infected persons. In the majority of instances, however, no such connection could be traced. The most remarkable instance of the kind which came under my own observation was the following:—At the end of July or beginning of August a nest of plague deaths occurred in a bustee in Roop Chand Roy Street. On the morning of August 11th at 7 a.m., I was called to a house No. 5, Municipal Street. I found two dead persons, a man and a woman, and two persons, a man and a boy, almost moribund. The two last were removed to hospital and both died within twenty-four hours. I made agar stroke and bouillon cultures from the bubo (where this existed), liver, and (in one case) the spleen from all four patients. In all, with the exception of the woman, I succeeded in obtaining pure cultures of a bacillus giving all the reactions of the plague bacillus. The external signs in the case of the woman left little doubt that death was due to plague, notwithstanding the failure to isolate the plague bacillus. Major Bannerman and Dr. Cook also succeeded in obtaining the bacillus from the two men. On further investigation I ascertained that each of these persons had had more or less direct connection with the cases in Roop Chand Roy Street. I constructed the following table which indicates the relation of the patients to each other and their connection with the earlier group of cases:—

Matai Halwai (M)=Bhagavati (F)

No occupation, lived sometimes with sons, sometimes with wife. Arrived from Doyahatta on 6th August 1898. Found dead 11th August 1898.

Wife of Matai Halwai, lived at 5, Municipal Office Street, but often went to Roop Chand Roy's Street, and spent days there. Had been in Doyahatta since leaving Roop Chand Roy's Street. Arrived 10th August 1898. Found dead 11th August 1898.

Ram Sarup (M)

Found ill and removed to hospital, 11th August 1898. Died same day. Had been in Doyahatta after leaving Roop Chand Roy's Street. Arrived 9th August 1898.

Deoki (M)

Had sweetmeat shop at 5, Cross Street, but lived at Roop Chand Roy's Street. Brought by mother to 5, Municipal Office Street, and died there 28th July 1898. Death not reported.

Ram Charan

Lived with wife, father-in-law, Ram Sarup, and brother-in-law, Jaiseri, in same house as Deoki, but in separate room. Died at 5, Cross Street, on 6th August 1898.

(M)=Daughter

Jaiseri.

Boy aged 4. Found ill, 11th August 1898, and removed to hospital, where he died 12th August 1898.

The bustee in Roop Chand Roy's Street had been compulsorily evacuated on August 7th. Whether the persons mentioned in the table were in the bustee at the time of its evacuation I was unable to ascertain with certainty, but it seems probable that four of them were. With one exception (that of Ram Charan's wife) the persons were all dead, and could, therefore, not be questioned as to their movements after the date of the evacuation. It was impossible to ascertain in complete detail what those movements were. But from the information obtained which is incorporated in the table it will be seen that two of the persons there named (Matai Halwai and his wife Bhagavati) usually lived at 5, Municipal Office Street, in the house where they were found dead on August 11th; that both of them were frequently in Roop Chand Roy's Street where the man sometimes lived and where the wife often stayed for some days; that the remaining five persons lived in the bustee in Roop Chand Roy's Street; that one of these five (Deoki) had a sweetmeat shop in Cross Street in which his brother (Ram Charan) died on August 6th, and that he himself (Deoki) had died nine days earlier in Municipal Office Street. It also appears that five of the persons named (*i. e.*, all except Deoki and Ram Charan, both of whom had died previously) had been to a certain house in Doyahatta, in another part of Calcutta, probably after leaving the Roop Chand Roy's Street bustee on the date of its evacuation, and that from there they all, with the exception of Ram Charan's wife, came to the house in Municipal Office Street, where they were found on August 11th. One, however, it will be noticed (Matai Halwai) had arrived there from Doyahatta on August 6th, the day before the evacuation of the bustee. The houses in Municipal Office Street, in Doyahatta and in Cross Street were disinfected, and there was no further spread of the disease in any of them. In addition to the above group of cases several other offshoots of the original group occurred in various parts of the city, but as these were outside the district of which I have charge, I am unable to give first-hand evidence concerning them. Whether the above persons contracted the disease directly from the patients at Roop Chand Roy's Street during life, or from their bodies after death, or from some source common to them all, as for example the soil, or some article of food there is no evidence to show. The question of

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the direct infectivity of plague from person to person or the "contagiousness" of plague is one of considerable importance. The occasional occurrence of the disease in groups of cases, attacked more or less simultaneously or if successively so rapidly as to leave almost no intervals for incubation, points to the existence in such cases of a common source of infection. This might be the air, water, food or the soil. I am aware of no evidence pointing to the possibility of the aerial convection of plague such as has been shown probably occurs in the case of small-pox, nor does there appear to be any evidence that it may be carried by water as in the case of cholera. The possibility of its spread by articles of food is still uncertain. The soil remains, and it appears to be almost certain that the soil may retain and transmit the infection. On the other hand, a direct transmission of infection from person to person does, I think, occur, though not very commonly. From my own experience I am convinced that plague is incomparably less "contagious" than typhus, small-pox, scarlatina or measles. Friends and relatives may visit and remain for considerable periods by the bedside of a plague patient with but slight risk of catching the disease, and this is certainly not the case in the diseases just named. To others, in more prolonged and closer contact with patients, as nurses, medical men, and hospital attendants, the risk is still small but appreciable, and I have already mentioned a considerable number of instances in which members of staffs have contracted the disease in the course of their duties.

7244. With regard to the people who went to Roop Chand Roy's Street, I do not quite understand what you wish us to infer from that table. Many of the cases occurred before the bustee was evacuated on August 7th?—Some of them.

7245. They all occurred during the period of incubation counting from the date of evacuation—I mean they might all have got plague from Roop Chand Roy's Street. Was there an outbreak in Municipal Office Street separately?—Only these four cases occurred there.

7246. These four people might all have come from Roop Chand Roy's Street?—Matai Halwai and Bhagavati were frequently in Roop Chand Roy's Street. Ram Sarup and Jaiseri lived there.

7247. You say that Ram Sarup had been in Doyahatta after leaving Roop Chand Roy's Street, arriving on 9th August 1898?—He arrived at 5 Municipal Office Street from Doyahatta on the 9th. All these persons had been in the habit of going to Roop Chand Roy's Street. The woman at any rate spent days in Roop Chand Roy's Street in the bustee.

7248. But it is nowhere stated that Jaiseri had ever been there?—Jaiseri lived in Roop Chand Roy's Street.

7249. When the bustee in Roop Chand Roy's Street was evacuated you say, that five people, including Jaiseri, went to a house in Doyahatta and from there they came to the house in Municipal Office Street?—Yes; I mentioned the case in order to show how localities might become infected by the movement of persons who have been in other infected districts.

7250. As far as I can understand the only ascertained cases were among their own relations, so that it is quite possible they moved without communicating it to other people?—That is possible.

7251. The bustee was compulsorily evacuated; was it not?—Yes.

7252. This is the bustee which the Health Officer referred to as having been specially treated?—I expect that is so.

7253. (*The President*)—You bring this forward as an example of human conveyance from one district to another?—Yes.

7254. Supposing that is so, to whom was it conveyed in the other district?—To Municipal Office Street. The movements of these people from an infected locality carried the plague infection or virus to a locality hitherto free from infection. Prompt measures of disinfection, etc., were in all probability the means of preventing the spread of the infection to other people in this new locality.

7255. To whom was it conveyed in Municipal Office Street?—Only these persons named. All the cases had direct communication with Roop Chand Roy's Street.

7256. (*Mr. Hewett.*)—When the bustee was vacated, those five people went to a particular man's house. I presume that is because they were turned out of the bustee?—Presumably.

7257. Therefore they must have been in the bustee before they were turned out?—Yes. I have already stated that they might all have been there.

7258. I suggest that as they all got plague within the assumed period of incubation it is quite possible they went from the bustee with plague upon them?—It is quite possible.

7259. So far as we know they did not communicate it to anybody else in Municipal Office Street?—No.

7260. The only thing you can say seems to be that it is an instance of how people turned out of an evacuated area may go into an area where there is no plague, and assuming that plague is communicable by them, communicate it to somebody; it does not prove the fact that they did actually communicate plague?—Yes, that is so. I think the prompt measures taken may have prevented any further spread of the disease in Municipal Office Street. A focus of infection which might have spread had been formed by the movements of these people.

7261. (*Dr. Ruffer.*)—I think you have some facts about persons having the plague twice?—Yes, I have notes of two cases in which a second attack of plague occurred in the same person. They are as follows:—

Case I, Register No. 910. Sweeper employed in the Parel Hospital. Hindu, male, æt. 17, was admitted to the wards on December 7th, 1897, with left axillary bubo and other symptoms of plague. He was discharged on 13th December, only six days after admission. So rapid a recovery points to an excessively mild attack of the disease. He was re-admitted on 18th March 1898 when I was in charge of the hospital. He was then very ill with many of the symptoms of plague and tenderness, but no swelling, in the right groin. He died four days later on March 22nd.

Case II, Register No. 1060. Hindu, female, æt. 12, was admitted to the Parel Hospital on April 12th, 1898, with symptoms of plague. It was ascertained that she had been treated in the Arthur Road Hospital, Bombay, and had been transferred as a convalescent to Parel in December; her first discharge from the Parel Hospital was dated 13th December 1897. The second attack in April was a severe one; there was a left inguinal bubo, from which plague bacilli were isolated. She died on 14th April, 47 hours after admission, and 55 hours after the onset of symptoms.

7262. You did not see these two cases yourself the first time they had plague?—No.

7263. Did you examine the records of the hospital?—I examined the records in the Parel Hospital in both cases.

7264. There was nothing like a bacteriological diagnosis made?—I am not aware that any such diagnosis was made in the first attacks. Plague bacilli were found in case II during the second attack.

7265. From what you have heard from the patient himself on the first case, are you satisfied that was a case of plague or have you any doubt about it?—The first case was a sweeper, an intelligent boy who distinctly stated that he had been treated for plague in that same hospital, and had been in the service of the hospital ever since.

7266. Did you find any record of the symptoms in the second case?—No, merely a note "Transferred from the Arthur Road Hospital."

7267. Did that case have bubo in the first attack?—It was not stated on the case sheet.

7268. It would be practically impossible to trace this case now?—It may be ascertained by the records of the Parel Hospital and traced from the case number.

7269. Will you kindly make the enquiries for us?—Yes.

[Note by witness on correcting proof of his evidence:—I will try and trace the case myself when in Bombay in April and forward the result.] *

7270. There are two cases in which you got positive evidence of the presence of the plague bacilli in the urine, what precautions did you take to see the vessel in which you received the urine was not contaminated by plague? Did you use a sterile vessel?—The vessel in which the urine was received from the patient was a urine glass, such as was used for all urines to be examined microscopically. The urine was drawn off by catheter.

7271. It was received from the patient in a vessel which had been in the hospital for some time?—Possibly.

7272. It might have been contaminated from an outside source?—I think it extremely unlikely as the urine glasses were thoroughly cleansed before being used.

7273. And in the second case the same thing may have happened?—The last answer applies to both cases.

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* For information supplied by witness see Appendix No. LXXXVII in Volume III of these proceedings.

7274. (*Prof. Wright.*)—Did you examine it very soon after it was passed ?—Yes, within an hour afterwards.

7275. (*Dr. Ruffer.*)—Were these cases males or females ?—They were both males, one had a cervical bubo.

7276. I suppose there was no possible contamination of the urine by fæces ?—No.

7277. With regard to the third man mentioned by you who had been inoculated and died, a very rapid case, in what part of the body was the inoculation done ? He had a left femoral gland you say ?—Yes.

7278. You say the first case from the jail had not been in communication with the second case ; on what day had he been discharged from jail ?—The note is 3 months and 26 days. The Medical Officer to the prison wrote that the second case "had never been in contact" with the first.

7279. It does not give the date ?—No.

7280. In the case of the Hospital Assistant who died of plague after pricking his finger I do not quite understand whether the bubo was on the same side as the cut ?—Yes.

7281. (*Mr. Cumine.*)—From the 6th May I think you have been in charge of eight wards in Calcutta—Wards XII to XIX ?—Yes. In the latter part of the time Ward XVIII was removed to another district.

7282. How did you get the news of cases having occurred in houses ?—An intimation was always given to me through the Special Health Officer in charge of plague.

7283. What was it your duty to do then ?—To make enquiries into the cases, to arrange for the removal of the patients to the hospital, if alive, and the disposal of the body if dead, and the disinfection of the premises afterwards.

7284. Did you generally hear of cases before or after death ?—A considerable number were heard of after death, but the majority of those in my district were heard of before death.

7285. When you heard of a case while the patient was still alive, did you always remove him to hospital or did you leave him in the house in some cases ?—In some cases they were left in the house.

7286. Did you find bad results occurring from leaving the patients in the houses ?—No.

7287. I suppose in the houses in which the patients were left there were means of segregating them, and keeping them in one part of the house ?—Yes. I have recollection of a European who was treated in that way and also a Eurasian. They are the only two cases I can distinctly recall.

7288. When it was determined to remove a patient to the hospital, what did you do with the other people in the room ? Our instructions were to endeavour to persuade them to go to the segregation huts.

7289. Were they generally persuaded ?—In no instance were they persuaded to go in my experience.

7290. Were they left in the room or turned out of the room ?—All cases in my division of the city were temporarily turned out for the purpose of disinfection, and then allowed to go back again directly.

7291. After how many days did they return as a rule ?—Within the next day or two, I think.

7292. Was there any watch kept upon the places that they went to while disinfection was going on ?—No.

7293. Have you any instances to show that they carried infection with them to places where they lived, while disinfection was going on ?—No.

7294. Was disinfection efficient in preventing people from getting plague when they came back into the rooms again, or did you find cases recurring in the disinfected rooms ?—I had no instances of cases occurring in disinfected rooms.

7295. If they had occurred would you probably have known of them ?—If they were among the 230 cases reported I should probably have heard of them.

7296. What disinfectant was used ?—Perchloride of mercury.

7297. Was it spread with a small hand-pump or thrown in bucketfuls ?—It was spread in small pumps. I did not supervise the disinfection ; the disinfecting arrangements were entirely in the charge of the Assistant Health Officer.

7298. Has it come under your notice that natives segregate in their own houses persons suffering from small-pox ?—I have no experience of small-pox in India at all.

7299. When a fresh case was reported to you did you always endeavour to find out how the infection had come to that place ?—I always made enquiries on that point.

7300. How did it come in most cases ?—In most cases I could find nothing to point to the means by which it had come.

7301. (*Prof. Wright.*)—You have told us of cases where you saw plague attacking people who were in contact with plague patients, have you ever seen in persons who were in attendance on the sick any other symptoms, short of actual plague, any swollen glands, for instance, which have not culminated in plague ?—No.

7302. Have you seen any local manifestations of plague in the form of carbuncles ?—In my experience the following are the commonest local lesions in plague, apart from buboes :—1. Localised collections of pus, or sero-pus or pus mixed with blood on an inflamed base, which on bursting or being opened leave an ulcer slow to heal. The ulcer is usually very sloughy. The original collection may be a large abscess, or it may be small and either furuncular or pemphigoid in character. 2. Patches of necrosis of the skin, varying much in size. They may be in positions which point to pressure as a cause (*e.g.*, on the occipital protuberance, over the sacrum or on the heel). They may occur where native caustic applications (such as the "marking nut") have been applied. They may occur in any other part of the body, apparently idiopathically. They often develope very rapidly, and the first stages may be missed. Sometimes they commence as a blackening and drying up of the epidermis and dermis, a shallow, granulating *plaque* being the result. Such *plaques* often closely resemble the ulcers left after discharge of the pemphigoid bulla above referred to. 3. Necrosis of the gland and the skin over it, both coming away together as a large slough, and leaving large, deep and irregular cavities which are very slow in healing. 4. Small blebs are often seen between the fingers and toes. They contain a watery or thinly purulent fluid, and generally give little trouble in healing. They may be found on the patient on admission, and have been regarded by some as local manifestations of the plague virus at its point of entrance to the body. I do not think they can be so regarded, for the site of inoculation, even in plague contracted through a *post-mortem* wound, shows no reaction, and, moreover, I have seen them develope in a patient some time after admission, when the other symptoms were fully developed. None of these lesions quite corresponds to the definition of an ordinary surgical carbuncle.

7303. You think some of these things have been due to local irritation ?—Yes.

7304. You did not examine into the local lesion bacteriologically.—No, microscopically I did, but never succeeded in discovering typical bacilli.

7305. You say that Yersin's serum was put up in small glass flasks ?—Yes, perfectly white glass, not very thick.

7306. Did they break with a jerk when you saw them ?—A slight jerk, the attendants knew exactly how to file them to the right depth so that they could be broken with great care and very little jerk ; it was very easy.

7307. Was the bottle inverted ?—No, the bottle was held by the assistant. With a needle you can empty it completely.

7308. Is an ordinary needle long enough ?—Yes.

7309. Would the method be applicable to putting up vaccine ?—I think it would be very suitable in cases where a large amount of vaccine lymph is to be stored. The size would be too large for storage of single doses of vaccine lymph, for which capillary tubes are more suitable.

7310. Is a skilled assistant required for the purpose of opening these bottles ?—No, they are merely filed round the neck ; any one can learn it by being shown once.

7311. (*Dr. Ruffer.*)—I believe you have clinical records of each of the fifty cases treated by Yersin's serum ?—Yes.

7312. (*The President.*)—I think you said you are prepared to place them at our disposal ?—Certainly.*

(Witness withdrew.)

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*See Appendix No. XXII in this Volume.

LIEUT.-COL. E. G. RUSSELL, I.M.S., called and examined.

Lieut.-Col. E. G. Russell.

30th Dec. 1898.

7313. (*The President.*)—You are Professor of Materia Medica in the Medical College Hospital at Calcutta ?—Yes.

7314. And you have had the treatment of cases in that hospital ?—No, scarcely the treatment. They were treated by the First Physician and by Dr. Evans, the Resident Physician. I saw them more as a visitor. We have each our ward and the plague cases were made the ward for the first physician, that is, first Dr. Bomford and then Dr. Harris, so that they were not under my care. I visited them for my own instruction and observation.

7315. Is there any particular point you wish to communicate to the Commission with regard to your observation ?—I should like to mention the fact that those cases which I saw were treated as plague cases, which I believe has been disputed a good deal.

7316. You have no doubt they were plague ?—I have no doubt.

7317. The symptoms did not vary from the symptoms of a plague patient ?—I think not.

7318. With regard to the nervous symptoms have you observed any aphonia in these patients ?—Nothing has impressed that upon my mind as a prominent symptom.

7319. Have you seen anything particular in the eye-symptoms ?—Nothing characteristic.

7320. (*Mr. Hewett.*)—Have you practised generally among the natives of all ranks in Calcutta ?—Yes, a consulting practice, I should say.

7321. Have you ever seen any bubonic cases of fever clinically resembling plague ?—Not clinically resembling plague. I have practised in Assam and Lower Bengal for 26 years, and I have observed nothing resembling plague to any marked extent.

7322. Some people think that there is such a form of bubonic fever in Bengal ; do you consider that opinion to be purely theoretical ?—Yes, I never heard of that theory until plague came this year.

7323. You do not believe it ?—I do not accept it.

7324. Have you any theory as to why plague has not spread much in Calcutta ?—I am afraid not. I should like to make an observation about segregation, as to the relative necessity of segregation in small-pox cases as compared with plague. I think that the cases are by no means parallel. Small-pox necessarily comes among people voluntarily vaccinated and therefore less likely to become infected. The sufferer himself has been vaccinated, and therefore the type of the disease is probably not severe. I believe if inoculation were universally accepted as small-pox vaccination is, plague and small-pox would perhaps be more on a parallel with regard to segregation, but until that is the case I do not think they are on precisely the same footing.

7325. When you say that vaccination is generally accepted I presume you refer to particular areas ?—I was speaking for the moment of Calcutta.

7326. Do you think that the danger of allowing small-pox patients to be segregated in their own houses is minimized by the fact that a great proportion of the people in the house have been vaccinated ?—Yes.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Home Office, Calcutta.

TWENTY-FIRST DAY.

Saturday, December 31st, 1898.

PRESENT :

PROFESSOR T. R. FRASER, M.D., L.L.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.

PROFESSOR A. E. WRIGHT, M.D.

MR. A. CUMINE.

DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

MR. W. A. JUSTICE, M. B., called and examined.

Mr. W. A. Justice.

31st Dec. 1898.

7327. (*Mr. Hewett.*)—You are now employed by the Government of Bengal ?—Yes.

7328. And were originally employed in Bombay ?—Yes.

7329. How long were you employed in Bombay ?—From the 11th of February to the 29th of April.

7330. When did you come to Calcutta ?—I arrived here on the 1st of May.

7331. The main point upon which your evidence is to be given is the outbreak which took place in the Backergunge district ?—Yes.

7332. How far is this district from Calcutta ?—I do not know the exact distance in miles ; you start from here at half past nine at night and arrive at eight o'clock the next night.

7333. In what direction ?—East.

7334. You were not present when the outbreak began ?—No.

7335. Did you go there when it was reported that plague existed there ?—Yes.

7336. And are you prepared to tell us not only of your own observations but of the results of enquiries which were made there by local officers ?—Yes.

7337. In how many villages did plague occur ?—Two—Siddhakati and Abheynil.

7338. How far distant are they from one another ?—A mile, or so.

7339. What is the character of those villages ?—They consist of thatched huts : the country is waterlogged.

7340. And liable to floods during the rains ?—Yes ; it was during the rains I was there. The huts seemed to be separated from each other by water.

7341. Do they have moats round the huts there ?—Yes ; the hut is elevated on a platform called a plinth in the country.

7342. How high is the plinth ?—Three feet.

7343. What was the type of the disease which you found in those two villages ?—Purely pneumonic.

7344. How many cases were there ?—11.

7345. How many of them recovered ?—None.

7346. Can you tell us how infection was carried from Calcutta to those villages ?—It appears that the infection was conveyed from the house of a Kaviraj (native practitioner).

7347. He used to lecture to students ?—Yes.

7348. Is there anything to prove that he himself had plague ?—Not as far as I know.

7349. Did a certain number of his pupils die ? —Yes.

7350. Can you tell me how many died in Calcutta between the 16th and 31st August, inclusive ?—No. My information only goes as far back as the 27th of August, when Sitanath Sen fell ill.

Mr. W. A. Justice.

31st Dec. 1898.

7351. It is important that we should get the number that died in Calcutta. If you refer to the Health Officer's report I think you will find four died in Calcutta?—Yes.

7352. With whom did Sitanath Sen live?—He lived with Girija Prosanno, a pleader in the High Court of Calcutta.

7353. When did Girija Prosanno leave Calcutta?—On the 30th August.

7354. Did he go by himself?—No; he went with his two nephews—Upendra and Surendra—and a servant named Tarak.

7355. When did they arrive in their village?—The next day, the evening of the 31st.

7356. Did this man Girija die of plague in the village?—Yes.

7357. When did he fall ill?—On the 1st September, and died on the 6th September.

7358. What was the next case in the village?—Upendra fell ill on the same day, the 1st of September, and died on the 4th September.

7359. Was the other nephew attacked?—No. He was kept under observation for 14 days.

7360. Girija lived in a superior masonry house, did he not?—Yes.

7361. Was he a relative of the land-owner there?—Yes.

7362. Did you evacuate his house?—No. The house was only disinfected and whitewashed.

7363. When was that done?—I could not say the exact number of days after the death.

7364. Was it done before Girija's wife was attacked?—No.

7365. When was she attacked?—Girija's wife, Binodini, was attacked on the 9th; she died on the 12th.

7366. Did any more cases occur in that house?—No.

7367. Do you know how many people continued to live in it?—I do not know. The house is a very large house, and I believe a large number of people lived in it.

7368. What happened to the servant Tarak?—He went on to his father's hut in the same village, about a mile distant from this pukka house.

7369. Did he die of plague?—Yes.

7370. When was he attacked?—On the 2nd September, and he died on the 5th.

7371. He had some relations besides his father?—Yes, he had a sister, Ramani, who was the wife of Lakhi Some.

7372. Which of them was the next to be attacked?—Lakhi Some.

7373. Where did he live?—At Abhoynil, a village a mile further on.

7374. When was he attacked?—On the 6th, and died on the 9th.

7375. Do you know of any communication which took place between Lakhi Some and Tarak?—Yes: Lakhi Some went to see his brother-in-law immediately on his arrival.

7376. On the 1st September that is?—Yes.

7377. Who nursed Lakhi Some?—His wife, Ramani.

7378. His father-in-law's name was Baikuntha?—Yes.

7379. Was Baikuntha living in the same house?—No, he lived in Tarak's house.

7380. Did not Baikuntha nurse this man Lakhi Some?—Yes.

7381. When were Ramani and Baikuntha, respectively, attacked by plague?—Ramani fell ill on the 13th September and Baikuntha on the 14th.

7382. And when did they die?—Ramani died on the 16th and Baikuntha on the 17th.

7383. Did anybody else visit Lakh Some when he was ill?—Yes, he was visited by Mukta.

7384. And Mukta was the only person who saw him, to the best of your knowledge?—Yes; she visited him on the day before his death. That was her only visit.

7385. Is she known to have touched the patient?—Yes, she felt his pulse.

7386. When was she attacked?—Mukta fell ill on the 13th, and died on the 16th.

7387. Do you know who cremated Lakhi Some?—His father-in-law, Baikuntha.

7388. Do you know who attended Baikuntha?—His wife, Kamini.

7389. When was she attacked?—She was attacked on the 20th, and died on the 23rd.

7390. There was a neighbour of the name of Ramnidhi; was he present at the cremation of Lakhi Some?—Yes.

7391. Did he assist at it?—Yes.

7392. When was he attacked?—He was attacked on the 14th, and died on the 16th.

7393. Who nursed him?—His wife, Harsundari.

7394. When was she attacked?—She was attacked on the 20th, and died on the 22nd.

7395. Did she also attend his cremation?—Yes.

7396. Which of these patients did you see yourself?—Harsundari and Kamini.

7397. The two last cases?—Yes.

7398. What type of plague were they suffering from?—Very virulent pneumonic plague.

7399. How many houses in all were attacked in these two villages?—Six, I think.

7400. Did you evacuate all except Girija's house?—Yes.

7401. Did you burn them?—Yes.

7402. How many contacts did you get hold of?—Ten.

7403. Are you perfectly certain that you got hold of every contact?—Yes.

7401. What did you do with them?—We put them into boats.

7405. For how long?—14 days.

7406. Was there any case among them after that?—No.

7407. Have you anything to say with regard to the immunity of persons of particular ages?—Yes. Mona, the grandmother of Tarak, attended all the sick members of her family. She nursed Kamini, Baikuntha and Tarak; she was present all the time, and escaped. An old woman who nursed Mukta escaped also. There were also three children with Mona who had been exposed to the same infection the whole time; in fact one of the children was sucking Kamini's breast at the time I reached the hut. Yet all escaped.

7408. Have you anything to say with regard to the period of incubation judging from these particular cases?—From three to five days.

7409. On what do you base that conclusion?—Principally on the case of Mukta. She went to see Lakhi Some the day before he died; Lakhi Some died on the 9th September.

7410. She saw him on the 8th?—Yes, and was attacked on the 13th.

7411. Can you say what was the longest period that elapsed between the date when any of these persons was subject to infection and the date on which plague developed?—The longest period is in the case of Girija's wife, who had been exposed to infection probably from the day of arrival in Siddhakati, and she became ill on the 9th and died on the 12th.

7412. Did she come with her husband?—No. She was in the house at Siddhakati.

7413. That was 8 days?—Yes.

7414. Do you attribute the complete stoppage of the outbreak to the fact that you were able to isolate and segregate the whole of the contacts immediately?—Yes.

7115. And you had them under complete observation?—Yes.

7416. Do you think that the disinfection of the house of Girija prevented the outbreak spreading there?—Yes.

7417. You washed all the contacts?—We washed all the children from Abhoynil.

7418. And the grown-up people?—We gave them something to wash with.

7419. Did the disposal of the dead in this village cause trouble?—Yes.

7420. The people were not prepared to cremate their own dead?—No.

7421. Is there an instance of a Hindu woman burying a plague patient herself?—Yes. Mona buried her grand daughter.

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7422. Was it found impossible to get the natives to cremate some of their dead?—Yes.

7423. Who were the Europeans who did it for them?—Mr. Bell, the Collector, Mr. Savage, the Commissioner of Dacca, Mr. Hyde, the District Superintendent of Police, and myself.

7424. Can you tell us from what you learned from the village, when the Collector heard of this outbreak?—He heard it about the 6th or 7th of September. He went up there, and was present at the cremation of the first man, Girija. Of course Lakhi Some was ill at the time, and no one mentioned it to the Collector.

7425. Were there any native practitioners in the village?—The Assistant Surgeon was there.

7426. Was he the man who found that plague existed there?—No; it was quite accidentally discovered. Girija wanted better advice, and sent for the Civil Surgeon of Barisal, but he was away on tour, and they sent the Assistant Surgeon. Suspicion was at once aroused.

7427. That is how the information got to the Collector?—Yes.

7428. And he was enabled to get on the spot earlier than usual by reason of the Assistant Surgeon being called in to attend to one of the patients?—Yes.

7429. Did you find that the people assisted you in any way?—Yes; they were very good.

7430. Have you any observations to make with regard to your experience in Bombay or Calcutta?—In Calcutta I have seen three cases in my own district, all of the bubonic type. Two of them had buboes in the right inguinal region, and another had a bubo in the neck. One recovered. They were peons in the High Court and I can only attribute their infection to rats, a number of which was found in the neighbourhood of the High Court.

7431. Is the High Court in the district of which you are in charge?—No.

7432. They were living in your district, but you considered they got their infection from outside?—Yes.

7433. There have been no other cases of plague in your district?—No.

7434. You were not able to trace any connection between these particular patients and any others suffering from plague in any other district?—No.

7435. Nor can you trace much connection between them and rats?—No.

7436. You only knew that rats died?—Yes.

7437. These men would not necessarily go to the godowns where the rats were found?—No.

7438. Is there any other point you wish to mention?—I should like to state that, in my opinion, the reason why plague has not spread in Calcutta is because of the bustees in which the poorer classes live.

7439. Will you give your explanation of that?—I think they are more open to light and air than the chawls of Bombay.

7440. You think they are less likely to nourish plague than the chawls of Bombay?—Yes.

7441. Certain portions of Calcutta are very much congested, are they not?—Yes, the western portion near the river consists of pukka houses, which are very dirty.

7442. With more than one storey?—Yes. And they are very dark and that is where the majority of plague cases have occurred.

7443. In the bustees you get huts of only one storey which are very much open to the action of the wind?—Yes. What one would have thought was going to be the scourge of the place has really been its salvation.

7444. (*Professor Wright.*)—How many of these cases which you report were seen by a medical man?—Three.

7445. Were they all pneumonic cases?—Yes.

7446. Were there buboes in any of these cases?—No.

7447. What evidence have you that the other cases belonged to the pneumonic type?—The evidence of the two Assistant Surgeons.

7448. How many of the whole cases were seen by doctors?—Five, including the two seen by myself.

7449. The Assistant Surgeons saw three in addition?—Yes.

7450. Six cases were not seen by anybody?—That is so.

7451. In the cases which you saw there were no buboes?—No.

7452. Then with regard to the other three cases seen by the Assistant Surgeon?—There were no buboes.

7453. Were the Assistant Surgeons competent and careful men?—Yes.

7454. You think you can rely upon their evidence?—Yes.

7455. With regard to the other six cases, I think, you said they were all of the pneumonic type?—Yes: of course we got that information from their friends. They had cough with expectoration.

7456. You say the man and his two nephews left Calcutta: were they ill when they were travelling?—No.

7457. They thought they were in complete health?—Yes.

7458. They went away on the 30th August?—Yes.

7459. And were taken ill the next day?—On the 1st September. They were travelling on the 31st, and arrived at 8 o'clock at night. The next day they fell suddenly ill.

7460. (*Mr. Cumine.*)—As no cases of plague developed amongst the segregated people, which do you think the most important thing, having put these people on one side or having taken them out of the infected houses?—Taking them out of the infected houses and giving them fresh air.

7461. That would prevent them from getting the disease and their segregation would prevent them giving it to others if they had developed it?—Quite so.

7462. (*Dr. Ruffer.*)—Did you make a bacteriological examination of any of these cases?—No; I took the necessary appliances with me, but unfortunately lost them in the river.

7463. Had any of these cases got buboes?—No; the only enlarged gland, about the size of an almond, was in the case of Harsundari, the wife of Ramnidhi.

7464. How are you sure that these cases were not ordinary cases of infectious pneumonia?—By the character of the sputum. It was not like ordinary pneumonia. The sputum was fœtid early in the course of the disease. In ordinary pneumonia you would hardly expect the sputum to be fœtid at so early a stage.

7465. Have you found that to be one of the characteristics of plague pneumonia?—Yes.

7466. There are epidemics of pneumonia, for instance in Europe, where there is no plague?—Yes.

7467. Are you quite satisfied that these were really cases of plague?—Yes.

7468. But in no case did you notice buboes nor did you make a bacteriological examination?—No.

7469. (*The President.*)—Have you notes of these cases?—I have clinical notes of my own on the cases of Harsundari and Kamini and notes of the Assistant Surgeon who saw three others. They are as follows:—

"CASE I.—BABU UPENDRA NATH RAI CHAUDHURY, NEPHEW OF BABU GIRIJA PRASSANNA RAI CHAUDHURY, AGE 13 YEARS.

"*Previous history of the case.*—Recently arrived from Calcutta, about three days before our arrival, with slight fever and bronchitis. He led a very irregular life as to diet and regimen after arrival. He had a very sickly constitution.

"*Present symptoms on our arrival. The 3rd September 1898, at 9-30* A.M.—On our arrival we found the patient a little delirious at times. Had retention of urine in the bladder, and the bladder was fully distended. We carefully examined both the inguinal and femoral region, because he came from Calcutta, and found none swollen. We also examined all the lymphatic glands, and found none swollen. On recording the temperature we found it to be 101°F. Examined the heart and the lungs very *carefully*, and found the heart very weak and pneumonic consolidation in both the lungs at their bases. The pulse was found very quick, but regular. The patient could answer questions put to him and could ask for food. Could swallow medicine easily. Complained of no pain elsewhere. The bowels were made open with enema to remove costiveness. Passed two round worms from the intestine. To remove retention of urine a metallic catheter, No. 8, was passed into the bladder.

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The urine voided was high coloured, but *not* offensive. Stimulating line of treatment was adopted, and the patient slightly improved. But on the 4th September, from the morning, the day after our arrival, the patient grew restless, and suffered from difficulty of respiration. The pulse became imperceptible and highly compressible and gradually absent at both the wrists. He continued in that state till 11-30 A.M., and then expired.

"*Causes of death.*—Gradual suspension of the heart's action and pneumonia.

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Medical Practitioners."

I obtained some further particulars from the doctors. They were the following:—The temperature ranged from 101°F. to 105°F. during his illness. No tenderness was noticed in any of the lymphatic glands. No congestion of the eyes. Tongue thickly coated with red edges. Patient conscious at times, but generally relapsed into unconsciousness. Delirium, and finally, the delirium getting worse, the patient died on the fourth day of his illness.

"CASE II.—BABU GIRIJA PRASSANNA RAI CHAUDHURY, AGE ABOUT 35.

"*Previous history.*—Recently arrived from Calcutta in apparently good health. Supplied history of diabetes. Had an attack of high fever on 1st September 1898, the day after his arrival from Calcutta.

"*Present condition, 3rd September, the day of our arrival.*—The temperature found ranging between 101°F. to 105·4°F., with constant fluctuation. Headache present. The pulse was a little intermittent. The heart on examination found to be very weak. (There is history of diabetes in the patient.) Bowels found not open. Urine free. There was anxious look present, indicating internal suffering. There was no actual difficulty of speech in him, but as the patient was very reserved naturally, he talked with some of his nearest friends and answered questions put to him. The bowels were opened with enema. Had several copious stools. The abdomen was a little tympanitic. We carefully examined all the glands, and found none swollen. The patient complained of no pain elsewhere, except pain in the head.

"After commencement of the treatment from the day of our arrival the patient was improving somewhat till 2 P.M. on the 4th September, the second day of our arrival.

"*4th September at* 7 P.M.—Slight difficulty of respiration and slight cough, with a rise of temperature from 102 to 103·4°F. The temperature was previously ranging between 100 to 102°F. We had a careful examination of the lungs, and found pneumonic consolidation at the base of the left lung. We came away at 2 A.M. on the 5th September, leaving behind full instructions as to treatment and sanitary measures to be adopted. We ordered thorough cleanliness of the house after the death of the nephew, and also ordered burning of the clothes and bedding used by the first case, to give a benefit of doubt to the public.

"*5th September at 4-30* P.M.—Got a telegram from Babu Jagat Prassanna Rai Chaudhury, brother of the second case. The body of the telegram is as follows :—

"Nose bleeding. Pneumonia-asthma. Expressed words understood."

"*Opinion.*—We left the patient in that state already described.

"*Conclusions and suggestions.*—It is very difficult without the help of a bacteriologist to arrive at a definite conclusion whether these two are plague cases or not. When we first saw the patients we were satisfied that these two cases were not cases of bubonic plague but of pneumonic, as there were no glandular swellings anywhere over the bodies of the two patients.

"On our return we studied plague in the *Indian Lancet*, May 1st, 1898. We came across the following :—

"'There are six types of the plague, namely,—

(1) Pestis Minor.
(2) ,, Ambulans.
(3) ,, Simplex bubonica.
(4) ,, Septica.
(5) ,, Pulmonalis.
(6) Non-typical forms of plague.'

"'Of these, the pulmonary form, which is usually *unaccompanied with bubonic swelling*, is the worst. It is a frightful source of spreading the infection from the sputum, which is loaded with plague bacilli,' etc., etc., *vide* the *Indian Lancet*, 1st May 1898. Now whether we are in a position to put these two cases under the 5th class the specialists are to decide.

RAJENDRA NATH GHOSHAL, L.M.S.,
NOBIN CHANDRA SEN,
Medical Practitioners."

The further particulars I obtained about Girija's case were the following :—Tongue clean and moist. Patient had a vacant expression. Quite prostrated. Delirium, but no tenderness in any lymphatic gland.

CASE III.—BAIKUNTHA (THE FATHER OF THE SERVANT OF CASES I AND II),

Was seen by the Civil Medical Officer of Barisal, from whom I obtained the following information :—

"The patient's tongue was clean and moist, and he put it out when asked to do so. His appearance was dull and apathetic. No congestion of the eyes was noticed : no glandular swelling ; but on pressing on the groin on both sides patient tried to remove the doctor's hand. He either would not or could not answer when spoken to. The pulse soft and about 100. Temperature about 102°F. The doctor did not take the temperature, but was of opinion that 102°F would be about the maximum. Cough with expectoration of a prune juice character and great fœtor of the breath.

"*Physical signs.*—Consolidation of the whole of the right lung. Bubbling râles all over that side. On the left side râles were made out posteriorly. On pressing, the doctor was inclined to think the sputum was more of a 'rusty' character than prune juice.

"The patient died on the 17th of September, the fourth day of his illness."

No scientific information can be obtained regarding the death of the servant of Cases I and II, by name Tarak. He died on the 5th of September.

THE CASE OF HARSUNDARI, THE WIFE OF RAMNIDHI.

This woman was the next door neighbour of the brother-in-law of the servant of Babu Girija Prassanna, Ramnidhi, who had died a few days before.

On receiving a telegram from the native doctor who had been watching the contacts of the previous cases that the wife of Ramnidhi, who had nursed her husband in his last illness, had a temperature of 103°F., the Collector and I forthwith proceeded to the spot. The hut which the patient occupied was a kutcha one, and raised above the marshy land surrounding it, on an earthen platform about three feet in height. It was quite isolated by water from any other homestead. The patient lay on her back, and was quite conscious. The conjunctivæ were slightly congested, and had a somewhat jaundiced tint. Her skin felt hot and dry. She appeared to have difficulty in breathing and complained of headache. The tongue was coated with a greyish fur, and was red at the tip and edges. The bowels were normal, and the appetite was good. She had a slight cough, with expectoration of seropurulent matter. Pulse was 120, thin and compressible. The heart sounds were normal, but very weak. Physical signs of pneumonia present in both lungs. On examining the lymphatic glands no bubo could be made out although there was a feeling of fulness under the right pectoralis major. The glands in the groin were slightly enlarged ; those of the neck were normal. On our return next morning we found the patient had just died. She had passed a very bad night, having been alternately conscious and unconscious. She died of exhaustion. Examination of the dead body revealed nothing fresh in the way of a bubo. The patient had only been ill a little over 48 hours.

THE CASE OF KAMINI, WIFE OF BAIKUNTHA.

The patient lived in a similar homestead. The native doctor found her quite well on the morning of the 20th, but on visiting her next morning, he found she had a temperature of 103°F. The same evening the Collector and I visited the patient. We found her quite conscious, but very restless and despondent. Her temperature had

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increased to 104°F. Her cornea was injected; her skin hot and dry. Tongue coated, but its condition was masked by betelnut staining. There was no bubo, but the glands in the groin were slightly enlarged, one being the size of an almond. There were no pneumonic symptoms at this stage. Pulse was quick 120, and of fair strength. Heart sounds were normal. Complained of headache and pains in the loins. Prescribed a stimulant mixture, and directed that as much air and light be allowed to get into the hut as possible. On visiting the patient on the afternoon of the 22nd we found that pneumonic symptoms had set in. Consolidation in patches over both lungs. The pulse was 120 and getting very much weaker. Heart sounds also weaker. Temperature 103°F. She had passed a very bad night; she was delirious, and had several times cried out in her sleep. Found no increase in the size of the glands, nor was there any tenderness. She had violent coughing fits, with profuse expectoration of fœtid purulent material, which exhausted her very much. She seemed to have lost all interest in her surroundings. She died early next morning.

7470. (*Mr. Hewett.*)—I understand that specimens of sputum were taken from Binodini two hours before death?—Yes.

7471. Do you know if they were examined?—They were examined by Major Evans.

7472. With what result?—Negative.

7473. How long do you suppose it took for them to get to Calcutta?—Under a week. It would take 24 hours to go from Barisal to Calcutta, 24 hours again to go to Darjeeling, that is supposing one caught the train direct on that day, and from Darjeeling they would have to be sent back to Calcutta and examined there. Of course you must take into consideration that the trains do not run to meet each other.

7474. They were sent to the Sanitary Commissioner who was not in Calcutta himself?—No; he was in Darjeeling.

7475. That was before you went to the village?—Yes.

(Witness withdrew.)

RAI BAHADUR KAILAS CHANDRA BOSE, called and examined.

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7476. (*The President.*)—You are a practitioner of medicine?—Yes, I practise medicine and obstetric medicine and surgery.

7477. What are your qualifications?—L.M.S., Calcutta Medical College.

7478. You also hold the office of Member of the Plague Commission of Bengal?—Yes.

7479. (*Dr. Ruffer.*)—You have had some experience of plague in Calcutta, have you not?—Yes.

7480. You have no doubt that plague did exist in Calcutta?—I have no doubt of it.

7481. Can you fix the date of the beginning of the plague in Calcutta?—It must have been about the beginning of April or the end of March last. The first case that came under my observation was on the 21st of April last.

7482. Was not one of the cases a man named Manmahan, a fifth year student of the Medical College?—Yes. It was either at the beginning of April or the end of March. That was the first case, and it was brought to our notice long before plague was declared officially. He inoculated himself during the *post mortem* examination of a patient who had died with suspicious symptoms in the Medical College Hospital. He developed septicæmic fever and had glandular swellings,—the cervical glands were affected. We thought he must have died from a disease other than the ordinary dissection wound and most likely from plague.

7483. Do you know who the patient was from whom he inoculated himself?—I do not know.

7484. Are you a member of the Staff of the Medical College Hospital?—I take an interest in the working of the Medical College, and I am a member of the Medical Society and therefore go frequently to the wards of the hospital.

7485. Were these two cases under your immediate notice?—No.

7486. It is mere hearsay?—I should say the report was from a reliable source.

7487. Did you see them yourself?—No.

7488. Have you any evidence to show that it was imported from some other place?—When the plague was raging rather virulently in Poona and Bombay, a body of men, at least 6 or 7, came from an infected area of Bombay, deceiving the Medical Inspectors at the inspection camps, and settled themselves in Bara Bazar.

7489. Where is Bara Bazar?—It is the most congested ward of our town: it is in the northern part of it.

7490. Do you know that of your own knowledge?—Yes.

7491. When did that occur?—One batch came by the middle of February last and another at the commencement of March last.

7492. Have you any reason to think that these people had plague?—No; only one man who came here said that his relatives and servants died of plague in Poona, and that he belonged to the batch which came to Calcutta direct from Poona. So that he must have brought with him contaminated clothes and bundles.

7493. Were they not disinfected on the way?—No; he managed to come, and the bundles came without being disinfected.

7494. But I thought they had to pass disinfecting stations?—In February and March they were not very particular about these things; the rules were rather elastic, and people could bring in their bundles safely. Even at Khana Junction, where we had disinfecting apparatus, people could bring their clothes safely by playing unfair tricks.

7495. You are quite certain of that?—Yes.

7496. Have you been there yourself?—Yes, I went twice to the Khana Junction.

7497. And you are satisfied that disinfection was not carried out?—The method is perfect, but there is no proper supervision. It was left entirely to the option of the dhobee and by some means or other valuable bundles were allowed to come without being disinfected.

7498. Is there any disinfection of articles carried by goods trains, for instance?—No, not to my knowledge.

7499. Have you a specific instance of a man bringing plague from Bombay?—No.

7500. It is merely suspicion on your part?—Simply suspicion and a guess.

7501. When did the mortality among rats come to your notice?—In March last and the beginning of April there was a heavy mortality among the rats. I believe I was the first man to draw the attention of our local plague authorities to that fact.

7502. When was that?—It was about the middle of April that I drew the attention of Dr. Dyson, as well as the Health Officer to it.

7503. How long had you heard of it?—I had noticed a heavy mortality among rats from the third week of March last. In one place I remember some hundreds of dead rats were strewn over the street.

7504. Have you any evidence to show that those rats died of plague?—No, I took no interest in the study of the cause of their mortality.

7505. I think you saw a case of plague in the middle of April at 40, Ezra Street?—Yes; it was on the 21st of April.

7506. Are there many people from Bombay there?—That is the portion of Calcutta where the Banniahs from Bombay come and settle.

7507. Were you able to trace any cases from that street to other parts of the city?—No.

7508. Did you see cases in other parts of the city?—Yes, Ezra Street forms part of Bara Bazar: it is in the Bara Bazar Ward. From Ezra Street it went eastwards towards the head of Canning Street.

7509. Did you trace a case from there?—Yes, I link it in this way. At No. 40, Ezra Street, one Magan Lal died of plague. His friend Cuchra, who used to live in the same room and nursed him during his illness, contracted the disease on the day following the death of Magan Lal, and died of plague; there was no glandular swelling; the nervous element was more predominant in this case. In Magan Lal the glandular swelling was typical. There was

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one man named Ram Sahai, otherwise called Shahadeb, who rendered menial services to those two men during their illness, and he contracted the disease. I sent him down to the Medical College Hospital, where he developed unmistakeable plague symptoms and died in two days. He used to live in premises directly opposite to those where Magan Lal and Cuchra lived. A coachman in the employment of the master of Ram Sahai, who used to help Ram Sahai, also died of plague. A man living in the same house with Ram Sahai developed a mild form of plague but recovered; he was under my observation. The convalescence was rather protracted. This man was in the service of the master of Ram Sahai, who was a broker of Messrs. Turner, Morrison & Co. The Sethis, who deal principally in rice, are constituents of Turner Morrison & Co., and used to resort to their broker's place daily. Every morning and evening you would find some dozens of Sethi sitting in the houses of their brokers, and one Seenia Sethi contracted the disease. He lived at No. 67, Canning Street, a place eastward to the house where Magan Lal lived. He died of plague. Then from this point it went northwards and attacked the adjoining house, in which a Muhammadan lad also died of plague. It then traversed over Bara Bazar towards Armenian Street, Roop Chund Roy's Street, Cross Street, and then in a zig-zag route to Cotton Street, Burtolla Street, Kalakur Street and Banstolla Street.

7510. There were many cases of plague all over the town?—Yes, there were; after the case of Magan Lal, but not before.

7511. Do you think that grain or articles of food may carry infection?—I do not believe it can. I have personal knowledge about this. In No. 15, China Bazar Lane, some thousand bags of grain came down from Bombay. They were stored in a godown. I was very particular about this, and I am glad to be able to say that there was no case of a suspicious kind of fever amongst the inmates of that house, who had a great deal to do with the storing of the grain.

7512. Do you think simple bubonic cases are infectious?—I do.

7513. At what stage of the disease?—That I have not observed, but all my cases could be linked together—that a man is capable of contracting the disease from constant attendence on a patient.

7514. Are pneumonic cases infectious?—I have only seen two cases of pneumonic plague.

7515. Have you any reason to suppose they were highly infectious?—From my personal experience I would say that only two cases died of pneumonic plague in one house. One died of pneumonic plague, and he was attended by a friend who also contracted the disease and died of pneumonic plague.

7516. Did anybody else die of plague in the same house?—It happened that the other inhabitants dispersed themselves after the death of the second man, and I could not trace them.

7517. Have you any evidence to show that people sleeping in the open air are less susceptible to plague than those sleeping inside houses?—From the cases of plague which were under my observation I should say that they occurred amongst men who lived in cooped-up rooms and ill-ventilated houses. I may indirectly infer that people sleeping outside are less susceptible to contract plague than those sleeping inside.

7518. Do you think houses in Calcutta can be efficiently disinfected?—No.

7519. Why not?—Generally speaking, the northern portion of Calcutta houses could be disinfected, but in Bara Bazar, of which section I am now speaking, the houses are badly built, irrespective of the rules of hygiene; they have dark rooms, ill-ventilated, and in most houses the sun can peep in only with great difficulty at noon. Several families and groups of families live in one house. The floors are not in order, nor are the steps and staircases; and the drains are all clogged.

7520. Why should not such a house be lime-washed, or flooded with perchloride of mercury? Is there any reason why it should not be done?—It is repugnant to the feelings of the people who live in this quarter; they think disinfection is injurious to their health. I do not know what they think, but at all events they do not allow our Medical Officers to disinfect their houses properly, and in their attempt to do it effectively they met with very bad results.

7521. But has not disinfection been carried out in Cross Street?—Yes, I did disinfect Cross Street satisfactorily and this I had to do after bringing all my influential friends together in one place and explaining the necessity of disinfection. It was carried out thoroughly by private individuals, and since then I have had no report of cases of plague in that street.

7522. Do you know whether cases of pneumonic plague might be traced from the registers of deaths at the burning and burying grounds?—The mortuary returns of our town are not very satisfactory; they only give an idea of the general number of deaths, but not an idea of the causes of death.

7523. Do you think that cases of plague are registered under spurious names?—Yes.

7524. Do you know any specific instance of that?—Yes.

7525. Could you give us the names?—Yes, Bindraj died of plague. I attended upon him and his body was disposed of, and the death registered as caused by chronic rheumatism. In another instance a girl died of plague, and her death was registered as caused by chronic dysentery.

7526. Were these patients all yours?—Two were.

7527. Did you give these certificates?—No; in this country, especially in this part of the country, we have not the practice of giving certificates, and the people can dispose of the bodies in any way they like.

7528. Who registered the deaths under those names—the friends?—Yes.

7529. Did you protest afterwards?—How could I know? When I sent the report to the Plague Authorities, and the Medical Inspector came to inspect, I learned that the death was registered under a different head altogether. I could not know that before.

7530. Do you think that the diagnosis of plague offers any difficulties?—I think that the presence of bubo alone is no indication of plague; the sudden onset of the fever with rapid prostration, headache and suffusion of the eyes, must all be taken into consideration along with the presence of the bubo.

7531. Have you any personal knowledge as to the effect of Professor Haffkine's inoculations?—No.

7532. Do you think the people would greatly object to inoculation?—I tried my best to induce our men to submit to the operation, but could not persuade them. They are deadly against it: I do not know why.

7533. Do you think that, in the event of plague breaking out in Calcutta, they would be inoculated?—I do not think they would submit to that process at all. I succeeded in inducing a few select friends of mine to submit to the operation—some 30 of them—and they were looked down upon by their caste fellows.

7534. Have you noticed any difference in the frequency of plague amongst old and young people?—I am inclined to say that old age offers an immunity or at least that elderly men are less susceptible to the influence of plague, because all my cases occurred amongst young and healthy people as also amongst middle aged men.

7535. (*Mr. Hewett.*)—You said that these persons who came from Poona settled down in the Bara Bazar: was that near Kapalitola, where the first recorded case was?—No: it was at least two miles from that place.

7536. Do I understand you to say that some of their personal effects had come by goods train, or that they brought them with them?—They brought them with them.

7537. Anybody can bring personal effects by goods train, cannot they?—If they like.

7538. Is it the custom to do so?—Not as a rule. They bring all their personal effects with them; they never allow their bundles to be carried into other compartments. They are very particular about it.

7539. How long have you been practising here?—Over 20 years.

7540. Have you ever seen cases of the bubonic type of fever which is said to clinically resemble plague?—No.

7541. I understand that formerly you were an opponent of inoculation?—Yes.

7542. Why were you converted?—At first I could not account for the theory of it: I could not see why the culture being desiccated by heat and then introduced into the system should be a prophylactic against plague. I was labouring under the mistake that one attack of plague did not offer immunity against a second attack, and therefore I thought inoculation could give no satisfactory results. Then from the facts which came under my notice I changed

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my mind and thought inoculation was the only remedy to be tried. I cannot explain the principle.

7543. Perhaps the people might have been generally converted to inoculation?—Yes; from facts and figures one cannot but believe in the efficacy of inoculation, whatever may be the principle.

7544. But unfortunately there were special circumstances here which at all events retarded, if they did not prevent people resorting to inoculation?—Exactly so.

7545. (*Dr. Ruffer.*)—Have you any evidence as to one attack of plague not protecting against another?—From the Bombay plague reports I see there have been two or three instances of a second attack.

7546. You allude to Dr. Weir's* report?—No, from General Gatacre's † and Mr. Snow's.*

7547. (*Prof. Wright.*)—Do you think there would be any objection on the part of the natives to corpse inspection in Calcutta?—Yes.

7548. Would there be an objection even to the inspection of male bodies?—Yes.

7549. (*Dr. Ruffer.*)—Supposing they were told that they must either get a death certificate from a medical man, or have corpse inspection, do you think they would submit to one or the other measure?—They would not yield to either of them.

7550. They would object to both?—Certainly.

7551. (*Prof. Wright.*)—What classes?—The Hindus and Muhammadans. The Christians have the custom of getting a certificate before the body is taken to the cemetery, but the Hindus and Muhammadans do not, as a rule, care much about medical certificates.

7552. (*Mr. Hewett.*)—Can you give us any idea of the proportion of people who die in Calcutta and are attended before death by a properly qualified medical man?—I cannot give you an exact idea.

7553. Are the majority attended?—Yes. All the well-to-do classes invite qualified men to see their patients during illness, and the poorer classes resort to hospitals or go to the nearest charitable dispensary.

(Witness withdrew.)

DR. W. C. HOSSACK, called and examined.

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7554. (*The President.*)—You are District Medical Officer in Division 1, Calcutta, for the Plague Commission here?—Yes.

7555. You have had some previous experience at Poona, I believe?—Yes.

7556. When did you go to Poona?—In December 1897 I remained there till May 1898—six months.

7557. What was the nature of your work there?—It was very varied; sometimes I was in medical charge of the segregation camp and sometimes in charge of the railway detention camp, and sometimes superintending the railway detention, sometimes supervising the issue of passes and sometimes doing corpse inspection. It was all broken up into shifts—morning, afternoon and night—so that it is impossible for me to give any statistics.

7558. You could not keep any records, because the work was so constantly changed and so broken up?—That is so.

7559. Have you formed any opinion as to the media of communication of plague?—Yes. When I was in charge of disinfection at the station in Poona, Dr. Cyril Cayley informed me that he had tested Bombay clothes before and after steam disinfection and had got plague culture. I should say that it would be important to get his evidence. This is not my evidence; I only call attention to the matter.

7560. Have you formed any opinion as to the method of infection?—Here, again, I can only call attention to the matter. In Poona it was repeatedly remarked that certain houses seemed to be specially infected. At one time, when a house was evacuated, a member of the family, or a darwan was left in charge, but it was found that this care-taker so often died, sometimes two or three successively in the same house, that the practice was given up. I can give no direct evidence, because this practice had been stopped before I reached Poona.

7561. This is hearsay?—Yes.

7562. Perhaps you can tell me whether these houses were disinfected after the person suffered from plague?—I can give no direct evidence; I simply wish to call your attention to it.

7563. Can you give any direct evidence with regard to the subject of the communication by rats?—Only with regard to a suspicious case in Calcutta. I can give direct evidence that I saw no rats in Poona, and that no rats were to be seen in Poona during the whole of my stay there. They were reported to have died.

7564. You were not there at the commencement of the epidemic?—No.

7565. They may have died out and disappeared?—They were reported to have done so.

7566. There were at that time no reports of plague in human beings so far as you know,?—Yes; plague cases were occurring in Poona at that time.

7567. So then plague went on steadily from one week to another, though there were no rats to aid in its extension?—Yes; it was decreasing however.

7568. Then I think you have had some experience with regard to preventive inoculation?—I can only cite some facts.

7569. What is the total number of cases you can speak to?—Four cases of plague in uninoculated Europeans. Dr. Knapp's case is of interest as showing the manner of infection. I was living with Dr. Knapp, and one day we noticed he was limping. We asked what was wrong, and he said he had a small ulcer near his ankle, the result of scratching a mosquito bite. He said there was slight pain in the groin. We then examined him and found a small ulcer about the size of a threepenny piece, and slight swelling and tenderness in the right or left groin, I forget which.

7570. Was it the same side as the mosquito bite?—I cannot remember that, but I rather think it was not. The details of this case could be got at the Sassoon Hospital. It came on gradually. I can give direct evidence on that point. He was in perfect health, and was not thinking about it at all. In fact, we did not think much about it that night, but we said to one another "Knapp is rather foolish," because he had not attended to the ulcer and had not dressed it, and we thought we had better keep an eye upon him. The next morning the symptoms were clearer. He had a temperature of 103, and his pulse was quick—out of proportion to the general symptoms. He went on and developed a typical bubo. I cannot give details of the case after that.

7571. Did he recover?—Yes.

7572. Had he been inoculated?—He had not.

7573. Have you any other cases?—Yes; Nurse Morgan died in Poona of pneumonic plague. I know it was pneumonic, because I examined a slip of the sputum: it was nearly pure culture.

7574. Did you see this nurse during life?—Yes.

7575. Did you attend her?—No.

7576. Did you examine her professionally?—No. She was attending a pneumonic patient, and got suddenly ill. She had not long been in attendance on the patient,—perhaps two or three days—and she died within 48 hours.

7577. Have you any other case?—No, none of which I can give details. With regard to a third case, an English lady who contracted plague in Poona, that was before my arrival, and I can give no details of that at all. I knew the lady and knew she had plague, and knew she had not been inoculated.

7578. Do you know of any cases which occurred among the inoculated?—None.

7579. Your duty in Calcutta, I understand, has been very much of the same nature as it was in Poona?—My duty in Calcutta has almost wholly consisted in the investigation of suspicious cases.

7580. How many have you done?—Altogether 160. I have been extremely busy lately.

7581. What is the result of your investigation?—I find that suspicious deaths have been occurring subsequent to October 27th in three particular streets,—Burtolla Street,

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* Report on the out break of Bubonic Plague in Bombay, 1896-97, by P. C. H. Snow, Esq., I.C.S.

† Report of the Bubonic Plague in Bombay by Brig.-Genl. W. F. Gatacre, C.B., D.S.O., Chairman, Plague Committee, 1896-97.

Banstolla Street and Cotton Street. In Burtolla Street I investigated 15 cases, 10 of which were suspicious. One of those was certified as plague by Dr. Bose.

7582. (*Dr. Ruffer.*)—When was that?—On October 26th.

7583. You had 15 suspicious cases in one street, I think?—I investigated 15 in Burtolla Street, and found that 10 were suspicious.

7584. Over what period did your investigations extend?—This portion is from October 27th to December 27th, 1898.

7585. How many of these were probable cases of plague?—In three of those cases I got a letter stating the case was plague and giving the particulars. That was from Dr. Bose. I got there in time to see one case, that was only three days ago. That case was one of plague.

7586. That was the only case which you saw in life?—Yes.

7587. What was the result of your examination?—I may give the following result of the investigation:—The condition which I found on examination, at 5 p.m., on the 27th December: child is drowsy, but responsive to questions and puts out tongue when asked. Lies huddled up on one side with legs drawn up. Very little injection of the eyes: tongue thick; white coat, with narrow pink edges, rather typical. Coughed once during examination. No physical signs of pneumonia. Pulse 172, respiration 52, temperature 104. *Buboes.* Above Poupart's ligament is distinct, diffused swelling extending right along its whole length. Below Poupart's ligament similar swelling. There is great tenderness, and the thigh is kept flexed. Examination vehemently resisted, so that further details could not be made out. On the left groin there is a small swelling and small shotty glands. Tenderness prevented detailed examination, but I could see inguinal and femoral glands on both sides were affected. The case clinically is distinctly plague.

7588. (*The President.*)—The symptoms are ordinary symptoms of plague?—Yes.

7589. (*Dr. Ruffer.*)—What is the after history of that patient?—The child died yesterday at 12 o'clock, *i.e.*, 29th December.

7590. Was a *post-mortem* examination of this case made?—No.

7591. Where did the child die, in the same house?—Yes, 10, Shook Lal Jaharry's Lane.

7592. Did you make a bacteriological examination?—No: it is impossible to get at the full history of the case: the people have to be treated with extreme tenderness. One cannot carry out proper measures.

7593. Did you make a bacteriological examination of the blood?—No.

7594. I suppose this case has been reported to the authorities?—Yes.

7595. And no doubt ordinary precautions were taken?—Yes.

7596. Do you know whether any other cases have occurred in this district?—Not actual cases of plague.

7597. Do you mean suspicious cases have occurred?—I mean suspicious cases have occurred.

7598. Can you very briefly tell the Commission what are the symptoms which cause suspicion?—In most of these investigations I could not get symptoms at all. It is with the greatest difficulty that we get any information at all in these cases owing to the temper of the people. Sometimes it is impossible, for instance, to discover even the owner of the house or the number of a house. I may say that what I have based my suspicion mainly upon was the information from a thoroughly reliable source that so many cases of plague had occurred in a certain house or houses. I would go there and find out that there had been deaths. These deaths had been after a short illness, and perhaps one of the deaths would be admitted to be pneumonic. All this would have to be extracted with the very greatest difficulty. Sometimes I could extract no reliable information at all.

7599. You generally arrived after death?—Always.

7600. Except in the one or two cases referred to?—Yes. There is only presumptive evidence that these were plague, but it is strong presumptive evidence, as the series of cases closes with a case which I have seen and which is plague.

7601. You have seen several which are undoubtedly cases of plague?—No. I have investigated several which I have a strong suspicion were plague. The end of the series culminates in a case which I have seen, and which turned out to be plague. That is the only one I have seen.

7602. In the others you had information from medical men?—Only in the cases seen by Dr. Bose. In the others the information was private and non-medical. The information given by the doctors in attendance was not in accordance with known facts and was absolutely unreliable.

7603. Will you tell us when these ten suspicious cases culminating in the case of plague which you observed yesterday occurred?—I can give the dates of some. I would like you to understand that many cases I quote as suspicious on very little medical evidence. I had very reliable information that they were plague and nothing to contradict that information.

7604. The evidence is that of medical practitioners: is it not?—In one or two cases: sometimes it was the evidence of the medical practitioner who had seen the case; generally it was legal evidence, not medical evidence.

7605. Can you tell me in how many cases you had evidence of doctors actually attending cases, and when those cases occurred?—In 4 cases of which the first is No. 91, the grandson of Umkar Mhow, of 45 Burtolla Street, who died on October 26th.

7606. Who was the doctor?—Dr. Bose.

7607. Any other doctor?—No; that is the only doctor. Then No. 90, Bundhu Singha Balgan, died on October 24th. That case died in the Medical College Hospital; I had to investigate it. Then No. 139 Gobind Lal Bagin, died December 9th, diagnosed by Dr. Bose. Then No. 141, Monalall, 10 Shook Lall Jaharry's Lane near Burtolla Street, died December 30th, diagnosed by both Dr. Bose and myself.

7608. That was a child?—Yes.

7609. Then there are three cases, excluding the one in the Medical College Hospital?—Yes; then there is another case in the Mayo Hospital, which died on the 27th.

7610. What were the measures which you adopted to prevent extension?—Segregation is practically abandoned. Orders were issued practically to abolish segregation in Calcutta. We were only allowed to segregate if the people were willing. Practically the effect of that was that there was no segregation. I can give a definite instance, if desired. This is the case of the dome who died in Alipur gaol compound on the 20th of May. With regard to the contacts, in my report I say that two other domes lived in the same hut. One was brought to assist with the ambulance. There were only two small boys with the ambulance and a distance of some four miles had to be traversed, and the dome was brought to assist with it and to be segregated at Manicktolla. The Deputy Superintendent of the gaol promised to send up the other dome as soon as he had collected his belongings. Both the men, however, disappeared. I had myself seen the man who disappeared from Manicktolla into the enclosure. I escorted the ambulance up. The other one disappeared from the gaol. The removal occupied from 7-30 A.M. till 11 A.M.; from 9-30 P.M. to 1 A.M. I was trying to get him removed on the previous night. It was an absolutely clear case of plague. With regard to the second instance, I may say there is no practical doubt that this was a case of plague. He was seen by a medical man just at the point of death; I think the man died 5 minutes after. I am referring to the case of the person in 7, Gobra Road South, who died on the 17th July. The Native practitioner examined the corpse and found a bubo. With regard to the contacts, the people showed me a small bustee hut removed from the original bustee, which they pointed out as the place in which they were willing to undergo segregation. I did not at all trust them, but I had to. I had to trust to the Vigilance Committee to arrange for their removal to this hut. The Vigilance Committee, however, failed to remove the four contacts, and the next morning, when the Health Officer's staff went to disinfect the house, they found it locked up and the key with a neighbour, and were told the contacts had left for some village, not known. This is typical of the disposal of contacts under the present regulations. The District Medical Officers have no powers, and contacts cannot be detained. It is useless to make arrangements, unless one has the staff to see them carried out. I made a note to that effect at the time.

7611. You lost sight of these contacts?—Yes.

7612. You do not know where they are?—No; I am the man who is supposed to find out.

7613. Have you other cases of a similar kind?—Yes.

7614. Your opinion is that plague under the present arrangements may be carried about by contacts?—Yes. Questions of policy have limited the application of preventive measures in the cases which have come under observation. For instance surveillance has only been occassional and

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non-systematic. I can give examples thereof of course. In the same way evacuation has only been partial.

7615. What do you mean by that?—I can give you a particular instance, the case of Deoki, Kahar, Nitollah bustee, Roop Chand Roy's Street, who died on September the 18th. Her case was diagnosed as plague pneumonia in the Medical College Hospital, and cultures were made from the lung, liver, bubo and spleen, which all gave characteristic growths of the plague bacilli, except the liver tubes. These cultures were made by Dr. Clemow. The house I describe is a two-storied kutcha house, that is, wattle-work, with seven or eight rooms and at least 30 inhabitants—a tenement house apparently.

7616. Well ventilated?—No.

7617. Is it sufficiently lighted?—No; I had a conversation with Dr. Green as to what should be done in that house. I said I saw nothing for it but complete evacuation. The rooms were very small, about 6 feet by 8, or perhaps 8 feet square. Only one room was effectually disinfected, and no evacuation was done at all for reasons of policy.

7618. What was the result? Did you follow up the history of the inmates of that house?—In a general way, and no subsequent cases developed to my knowledge. On the other hand, it is highly probable that if a case had developed, it would have escaped my observation; it could have been concealed successfully.

7619. Did you make a room-to-room visitation?—No, that would give rise to irritation, and was to be avoided.

7620. That is not done?—No.

7621. But there could not have been many more cases of plague among these people, or you would have heard of it?—Yes probably.

7622. Has the room which the patient occupied been disinfected?—Yes.

7623. Under your supervision?—No. The disinfection is done by the subordinate officer who was employed on the same duty in Bombay under the superintendence of Dr. Pettifer.

7624. What is Dr. Pettifer's office?—He is Assistant Special Health Officer. He can give details as to disinfection; that is not directly under me.

7625. Notwithstanding what you have said, it does not appear that plague became very common?—No; I should say it has not shown any signs of becoming epidemic. That statement I base on the general death-rate.

7626. Might not the inference possibly be that the measures which you have described were sufficient?—I do not draw that inference.

7627. Can you give any explanation as to why plague has not become prevalent, notwithstanding what you have said?—I have formed a strong opinion that there must be something in the environment in Calcutta inimical to the spread in epidemic form. What that factor is I have no idea. My opinion is that plague has been continuously here for 7 months—from April till now. I saw a case which died yesterday, and my opinion is it has been continually present, and yet I know it has not become epidemic.

7628. There has not been any large number of deaths?—No.

7629. You say that you are not able to account for the fact that plague had not become virulent in this place; did you hear what Dr. Justice suggested as an explanation of it just now?—No.

7630. He suggested that the construction of the bustees had tended to prevent the plague spreading here to the extent it did in towns of the construction of Bombay?—I rather differ.

7631. You do not accept that?—No; I have been engaged in a sanitary survey lately; I have rather particular knowledge of the bustees.

7632. Why do you reject Dr. Justice's view?—Some of the bustees are dreadfully insanitary, there is no light and air at all. The passages between the huts are three feet, two feet, or one foot. I have often seen a one-foot passage. The roofs meet altogether. The huts are two-storied; there is no light in the passages; surface drains either do not exist, or are broken, and always choked at the end. Altogether the sanitary condition of most of the bustees which we have yet examined is very bad.

7633. The policy has been to remove these bustees as far as possible: has it not?—As far as possible.

7634. They are being gradually removed?—Yes.

7635. I suppose that is the object of this survey?—Yes.

7636. So far as your observations go is it possible there might be a modified or a very mild form of plague, not fatal and not very serious?—It is possible. I came across a case of that sort in Poona. In Calcutta, owing to the circumstances I have detailed, such cases would never come under observation. As regards fever, with glands, I made some particular observations in Poona. I was in charge of the segregation camp there. The camp was for people who had come by road. While making the discharges of people who had been kept there for ten days I repeatedly came across cases with slight fever, and on examination I found they had glands as well as fever. At first I was in considerable difficulty as to what to do with those cases. They were numerous, and sometimes I would find ten out of a batch of one hundred. I detained some for five days beyond ten days, that is to say, they were under observation for the total period of fifteen days. I kept careful notes, but unfortunately those notes have disappeared. But I remember the conclusion I came to, namely, that those cases had nothing to do with plague at all. The glands were shotty. The fever in most cases was due to malaria. In one case it was tubercular apparently, and in another case it was venereal. But the conclusion I came to was that glands of that sort were very common in poorly-fed, low-caste natives, who are constantly exposed to malaria. In the railway detention camp containing people mainly from Bombay they were a better class, well-fed and of better physique. I found very few cases among them, though their numbers were much larger.

7637. Was there a bacteriological examination made of any of these cases?—None.

7638. Your observations do not support the view that there might be a mild form of plague?—In support of the existence of the mild form of plague I cite the case of Dr. Knapp. He went about for the first day or two and had nothing much wrong with him. He went about for at least 36 hours, and he had had it in him for 24 hours when I saw him.

7639. Is that the only case?—I came across slight cases—*ambulans* cases. I found a boy walking about the streets with bubo and fever. I discovered the ultimate history.

7640. Was it a case of plague?—It was plague.

7641. Why do you think so?—I carefully investigated for history of venereal and I got none, and it did not seem probable, because the boy was too young; also there had been previous cases of plague in the boy's family.

7642. Was there any direct evidence?—No.

7643. When you say that Dr. Knapp and this boy were mild cases, do you mean different forms of plague merely or mild attacks?—Mild attacks.

7644. When you say that cases of a mild form would not come under observation, I suppose you mean they would not come under the observation of the plague-officers?—Yes.

7645. But would they not come before the Native and European practitioners of the town if they were here in any numbers?—Yes; if they were here in any numbers, they would inevitably be noticed at the Native hospitals under Europeans.

7646. If European practitioners tell us they have not found in their practice cases of this nature, would it not be a fair inference that there are not such cases?—Yes, in their hospital practice.

7647. In their general practice, for instance, if such cases occurred in the practice of Dr. Bose, who was here just now?—Yes.

7648. Do you think mild cases like that of the boy you mentioned and Dr. Knapp may communicate the disease to another person?—I have no opinion on that.

7649. Do you think it is likely they would?—I should say so.

7650. How?—They probably carry some of the infection in their clothes—the original infection to which they were exposed.

7651. But leaving their clothes out of the question altogether, could mild cases infect any other person?—I cannot say.

7652. Do you think they could?—I do not know as to the infectivity of the secretions.

7653. What is your opinion as to the most frequent method of communication of plague: perhaps you have not seen a sufficient number of cases?—No, not in a systematic way.

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7654. Do you know anything of the infectiveness of clothes?—No, only what I have stated as to Dr. Cayley's experiments.

7655. In Calcutta have you any knowledge of the possible diffusion of the plague by rats?—The only case was one of suspicion only. There is no proof that the three men concerned in it died of plague. But there is a strong presumption. In that case I have direct evidence that dead rats were found before the men got ill, but there is no direct evidence that the illness was plague.

7656. (*Mr. Cumine.*)—Going to the period between April and October, I think forcible segregation of contacts was discontinued: but did you still continue forcible removal of patients?—Practically speaking, it was given up.

7657. After forcible segregation was abandoned,—after it became known to the people that there would not be forcible segregation of contacts did the contacts still run away when plague cases occurred? For instance, when you heard of a man having plague in a certain house, when you went there had the people disappeared?—I can only speak of suspicious cases. I have only three cases of plague. Generally speaking, at first they did, but latterly there is no scare and they do not run away.

7658. I do not ask you what happens now, but what happened in the period between April and October?—The scare was greatly modified. There may have been cases occasionally where a house was found empty. Instead of running away they began to give false information, or refused to give any.

7659. Did you find that fresh cases of plague kept occurring in any one room?—No; I was rather struck with the fact that they did not, to my knowledge.

7660. Do you think that the abolition of forcible segregation has produced bad results?—No; I do not.

7661. As each new case occurred, did it seem to you to have been brought by a refugee contact? Were you able to trace how the infection came?—In the great majority of cases it is absolutely impossible to trace the connection at all. All information is refused. One factor, I think, ought to be mentioned, and that is that the natives have got educated up to disinfection, and very frequently, when I investigated suspicious deaths, I found the natives had themselves disinfected their rooms and had them whitewashed or washed down with phenyle. That may be a factor in keeping the number of cases low.

7662. Do you believe that disinfection as practised by you is efficient?—No; for instance, going back to the case of this woman Deoki, she had probably been in other rooms and had been along the verandah. It was a kutcha house with clay walls and floors. If there was infection about, it was impossible the infection could have been confined to that one small upper room, yet that one small upper room was the only one disinfected. I say if there was any infection at all, that such disinfection was not enough to get the better of it.

7663. Of course disinfecting one room will not kill the germs in another room, but have you any reason to believe that the disinfection of a particular room did not destroy the germs in that room?—No; as far as I know disinfection was thorough in that respect.

7664. Did you find that although the cases did not appear to recur in the same room in Calcutta that they recurred in the same house?—I was rather struck by the fact that they did not; the recurrence was in the same neighbourhood.

7665. Did you notice plague cases occur among the washermen?—No; not a single dhobi. I do not remember investigating the death of a single dhobi.

7666. Is there any caste in Calcutta which is by custom entitled to get the clothes of a deceased person?—The domes at the Burning Ghaut do, as a rule.

7667. Have you ever traced a dome getting plague, because he had the clothes of a person who died from plague?—No.

7668. (*Prof. Wright.*)—Have you seen any enlarged glands in people attending cases of plague which have not culminated in plague?—No.

7669. How do you get on the track of suspicious cases here. Doctors' returns have been very few—there have been only three?—Practically you may put aside the doctors' reports altogether. All the Native doctors are in league to conceal cases.

7670. How do you get on the track of suspicious cases?—By extracts from the registers at the Burning Ghaut. An extract is made that so-and-so died after five days' fever. Perhaps there are several such cases in one street, and I go and investigate them. Sometimes I may get private information that there have been cases of plague in a certain street.

7671. (*The President.*)—How do you explain the fact that the Native doctors did not help you at all?—The general attitude of the whole population is one of the greatest antipathy to plague measures, and to plague officials, mixed up with a considerable amount of political feeling.

7672. Are you speaking of the Native doctors?—The doctors are thoroughly interested with the population in a combined effort to conceal plague and resist all the efforts of officials generally. That is my candid opinion. I have received information of Native doctors who made a practice of attending plague cases, and returning them at the Ghauts as cases of asthma or bronchitis. Asthma is a favorite diagnosis.

7673. Have you satisfied yourself that in some of these cases death is actually from plague?—No; there is no direct evidence that a Native doctor has attended a plague case and returned it otherwise.

7674. I think you said a moment ago that plague cases were often returned under some other name, and were certified as cases of asthma?—Perhaps I ought to have said that suspicious deaths are repeatedly returned wrongly.

7675. By "returned" you mean returned by the family and not by the doctors.—Yes.

7676. But some of the doctors have notified cases to you?—Only one.

7677. Are you speaking of doctors with English qualifications, as well as the Native doctors, or only of Kabirajes, Native doctors with Native qualifications?—Native doctors with Indian Degrees.

7678. And only one has ever told you of cases of plague?—Only one.

7679. And you know that other cases of plague have been attended by those doctors?—I can only say that I have received reliable information that they have, and that the circumstances, on investigation, pointed to that fact; but I have no direct evidence.

(Witness withdrew.)

MR. M. N. BANERJEA called and examined.

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7680. (*The President.*)—You hold certain English qualifications?—Yes; I am M. R. C. S. and L. S. A. (Lond.).

81. And you are in practice here?—Yes.

7682. Have you any official position in connection with plague?—No.

7683. (*Prof. Wright.*)—You have seen cases of plague?—Yes; I have seen about fourteen.

7684. During what months?—The first case I saw was in the middle of June last.

7685. And the last case?—The last case was about the end of September.

7686. When you find a case of plague, what is your practice with regard to reporting it?—I saw cases mostly in connection with the Vigilance Committee which we had in our Ward. We had a Medical Committee in connection with the Vigilance Committee.

7687. Did you not see any of those in your practice, or did you see them as a Plague Officer?—In both capacities; for instance, I was called to see a case of fever, and then when I suspected the case to be one of plague, I had to report it to the Committee and, through the Secretary, to the Health Officer.

7688. Have you ever seen any cases resembling plague before this year in your practice?—No.

7689. What do you think of the practice of disinfection? Do you think it is possible in the houses in which you have seen plague?—I think it is almost impossible.

7690. Why do you have that opinion?—Because the cases that I saw were mostly among the bustee people, and the construction of the bustees and the way the people live are both against proper disinfection. For instance, a hut

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may be divided into three or four compartments, all more or less one room, with more or less open partitions. People coming from one room would mix indiscriminately with people from another room, although they know that there is a suspicious case there. Even the patient's room cannot be disinfected thoroughly on account of its construction; but even though that room were disinfected, the other rooms will spread the infection just the same.

7691. Could not the whole hut be disinfected?—There are neighbouring huts; it might almost be called the same room; the huts adjoin each other in a line,—a bustee has about one hundred huts,—more or less communicating with each other.

7692. Do you find the Native doctors are injured in their practice by reporting cases of plague?—I myself ran a great risk, because there was a rumour against me that I was a man not to be relied upon, that I was sure to report if a case was suspicious.

7693. In cases of plague, do the Natives take precautions in the way of disinfection?—No, except the upper classes. The cases I saw were among the lower classes. They are all unused to take proper steps with regard to disinfection.

7694. (*Mr. Hewett.*)—Are there any Vigilance Committees now?—There are, but not in active work.

7695. Consequently, at the present moment you have to rely absolutely upon the doctors?—Yes.

7696. And do you think that you can do that as a general rule?—Yes, I do.*

7697. You disagree with the evidence of the last witness on that point?—I do not agree with him, because I have often got information from Medical Practitioners.

7698. You have yourself received information?—Yes. The information was sent to the Health Officer through the Vigilance Committee, and the Health Officer might not know that the information had been originally given by Medical Practitioners.

7699. At the same time there is a certain amount of difficulty?—Yes; there is some difficulty.

7700. What proportion of the people, in the portion of the town in which you practise, are attended before death by medical officers with English qualifications, as opposed to Native qualifications?—Of course very poor people are more or less attended by a class of practitioners of the Hospital Assistant type.

7701. What proportion do you think would come under the observation of doctors, either Europeans or Natives of this country with European qualifications, or Assistant Surgeons?—About one half.

7702. One half would be left to be attended by a Kaviraj?—Yes; and quacks.

7703. And you could not rely on the diagnosis of a Kaviraj?—No.

7704. You have seen cases of fever with glandular enlargements?—Yes.

7705. You do not believe in the prevalence of any bubonic fever?—Before this outbreak, no.

7706. You do not believe in that theory?—No.

7707. (*Dr. Ruffer.*)—How many people live in a bustee, as a rule?—It varies; it may be two hundred or more.

7708. What are the walls made of?—They are made of broken twigs, wood or bamboo.

7709. Why could not they be disinfected?—They do not present one surface; one portion is exposed to the disinfectants, and another is not.

7710. Still, could it not be done with time and care?—It is very difficult. It is a round bamboo which faces one room on one side and another room on the other.

7711. I am speaking of the whole bustee?—Oh! yes, the whole bustee could be disinfected.

7712. Do you think you could disinfect the floor: is it made of cow-dung?—The floor can be properly disinfected but the wall and the roof cannot.

7713. The whole of the bustee except the roof could be disinfected?—Yes.

7714. Do you think people would have much objection to their clothing being disinfected?—They would not object to the disinfection, but they do not like to have their things destroyed; if they object, it is because they think their things would be destroyed. Many people have a very crude idea of disinfection. Some of them think it means burning.

7715. But if you could satisfy them that nothing would be destroyed, and their goods were returned in the same state?—They would not object.

7716. They would strongly object to isolation and segregation, I suppose?—Yes.

7717. Do you think they would strongly object to people being taken to the hospital?—Not to the hospital. For instance, I could not induce patients to go to the Manicktollah Hospital; but when I proposed to send them to the Mayo Hospital, they did not object much.

7718. Supposing you were able to disinfect the bustees and had a sufficient staff to do it in three hours, and at the same time disinfected the clothing of the people and then allowed them to go back in the bustees, do you think they would have much objection? Supposing, for instance, they were only kept out of their houses from 11 o'clock till 2?—I think it would be difficult, especially where there are women in the bustees; of course men would not care, but women must have a place to go to.

7719. But supposing you had a camp, and took them to the camp at 11 o'clock, and allowed them to return at 2?—The women are generally very averse to leaving their homes.

7720. But supposing you tell them that they must either do that, or go to the segregation camp?—They would prefer the former.

7721. (*Prof. Wright.*)—What was the objection to the Manicktollah Hospital?—They had an idea that no one was likely to return from there.

7722. Why?—I do not know; but they got that impression: they say they are not properly treated there.

(Witness withdrew.)

(Adjourned till Tuesday, January 3rd, 1899.)

At The Home Office, Calcutta.

TWENTY-SECOND DAY.

Tuesday, January 3rd, 1899.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S., (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

SURGEON-GENERAL HARVEY called and examined.

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7723. (*The President.*)—You occupy the position of Director-General of the Indian Medical Service?—Yes.

7724. (*Mr. Hewett.*)—You are also Sanitary Commissioner with the Government of India?—Yes.

7725. Would you give us some description of your duties as Sanitary Commissioner?—The Sanitary Commissioner is the principal adviser of the Supreme Government in all matters affecting the health of the troops, the prisoners and

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* Note added by witness on correcting the proof of his evidence:—There has been a change since I gave that opinion and I find that the very men who willingly worked with me then are unwilling now to report cases.—M. N. B.,—22-2-99.

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the civil population. In fact all medical matters as to which Government wants an opinion are referred to him. He may suggest, or he may offer an opinion regarding any sanitary project, or any sanitary matter which comes before him; but he has no power of initiating anything. He has no money at his disposal; in fact he has no executive functions: he can only suggest. He is supposed to make tours of inspection, in the course of which he inquires into sanitary questions. He is also allowed to inspect jails and hospitals, and all medical institutions, and if he finds anything which he thinks ought to be brought to the notice of the Government, he is entitled to write a note on the subject which goes unofficially to the Home Deparment, for them to take such action as they may think fit.

7726. He reports on these matters to the Government of India ?—Yes.

7727. He has no power to interfere ?—He has no power to interfere, or to give orders to any local Surgeon-General, or any Inspector General of Civil Hospitals.

7728. The Government of India do not exercise direct authority over local sanitary officers, but give their instructions to the different Local Governments ?—Yes.

7729. Can you give some account of the duties of the officers who are subordinate to the Director-General as Inspectors General of Civil Hospitals ?—They are responsible for the efficiency of the medical service generally and the sanitary condition—each in their own Provinces. They have under them the Civil Surgeons, and now the local Sanitary Commissioners are in process of being put under them. They have general supervision. They make tours, inspect hospitals, and inquire into sanitary matters generally. They are specially responsible for vital statistics, and they may also make suggestions in the way the Director-General does, to their Local Government, for such action as the Local Government may think fit.

7730. What are the duties of Civil Surgeons ?—The Civil Surgeon is a man of very multifarious duties. He has to attend on the officers of Government; he is also, in most of the Provinces, more or less a responsible adviser of the local authorities in his district. He is supposed to exercise a general sanitary supervision over his district; and he is also in administrative, as well as medical, charge of the jail. He has to do all the medical legal work, make all the *post-mortems*, and that sort of thing. As he generally has a considerable amount of the work of the station, it is extremely difficult for him to get into the interior of his district and exercise any real sanitary control.

7731. Are the Civil Surgeons drawn materially from the Commissioned Medical Service ?—At present the great majority of Civil Surgeons in the important stations are Commissioned Medical Officers. For small stations there was formerly a service known as the Uncovenanted Medical Service. Some of these men were ship doctors, qualified men, who somehow or other had come to India, and wanted to get employment. They were cheaper than the Commissioned Officer, and therefore a class gradually arose, these people being sent to the smaller civil stations. Of late years we have ceased to recruit for this service and only those men now in it are to be retained. The vacancies now are filled either by Military Assistant Surgeons, or by Civil Assistant Surgeons. It was desirable to improve the position of this class of men and it was also desirable to increase the reserve of Military Assistant Surgeons in case of war, because when war breaks out, we want a number of additional Military Assistant Surgeons for the subordinate charge of field hospitals, and we had not a sufficient number of them.

7732. Are the Military Assistant Surgeons Europeans ?—They are *quasi*-Europeans: some Europeans, but the majority of them are Eurasians.

7733. The Civil Assistant Surgeons are entirely natives, are they not ?—Yes.

7734. You said, I think, just now, that the Inspector General of Civil Hospitals would have some responsibility as regards the vital statistics. I do not quite understand what that is ?—He has to collect them. If he finds that the vital statistics of a particular district are monstrously wrong, he generally calls the attention of the local authority to them with a view of trying to have them improved. The Sanitary Commissioner is now subordinate.

7735. You said just now that the Inspector General of Civil Hospitals had the right of inspecting all hospitals in a Province. Does that extend to all Municipal hospitals ?—I think so.

7736. Would you consider that the Inspector General of Civil Hospitals was responsible for inspecting the hospitals within the Presidency itself ?—Certainly.

7737. You have actually yourself been Inspector General of Civil Hospitals in the Province of Bengal ?—Yes.

7738. Did you consider it your duty to visit the hospitals in Calcutta ?—Regularly.

7739. And Government require an Inspector General to do that ?—I presume so. I do not know that I ever got any special orders, but I inspect the hospitals as a matter of course. I consider it my duty.

7740. Does not the Inspector-General of Civil Hospitals send the Government an annual report ?—I sent a special annual report on the Medical Institutions of Calcutta.

7741. Are these Government Medical Institutions or Municipal Institutions ?—The Municipality pays part of some of them. The Municipality, for instance, pays a considerable amount to Sealdah Hospital.

7742. Is it clear that the Bengal Government does expect the Inspector General of Civil Hospitals to inspect the hospitals at the Presidency town ? I ask that because the Surgeon General of Bombay disclaimed all responsibility.—It is clear.

7743. (*Prof. Wright.*)—Do you think that Plague Hospitals also come under that inspection ?—Yes, certainly, all hospitals.

7744. (*Mr. Hewett.*)—I understand that in the Bombay Presidency the duties of the Civil Surgeon are somewhat different from those in other Provinces ?—Yes. That is a point that I omitted in the duties of the Civil Surgeons. He has got to inspect all the local dispensaries in his district four times a year according to Government Regulations. It is a rule that is perhaps, to a certain extent, more honoured in the breach than in the observance, because it is often difficult for them, in consequence of their duties, and in some cases the remoteness of the dispensaries, to carry out the orders to the letter. Still they are supposed to do that. In the Bombay Presidency the Civil Surgeon has nothing to do with the administration of dispensaries. He is supposed to visit them once. An enormous amount of the Surgeon General's time is taken up in checking travelling allowances, and bills for Hospital Assistants, and people of that sort.

7745. He is less an administrative officer than he is elsewhere ?—The District Civil Surgeon is much less, I think, but the plan is distinctly cheaper, because in Bombay no Civil Surgeon has a clerk. Everywhere else he is allowed a clerk.

7746. In Bombay also the Civil Surgeon has no responsibility as regards sanitary matters inside the Municipality ?—Apparently not. I could not quite understand it but they said they did not interfere unless they were asked.

7747. But you would be rather surprised, I suppose, if in the Province of Bengal, or the North-West Provinces, or the Punjab, a Civil Surgeon told you that he had nothing to do with sanitary matters ?—I should be very much surprised. It is a recognized part of his duty.

7748. What are the duties of a Sanitary Commissioner with a Local Government ?—The Sanitary Commissioner is responsible mainly for vital statistics. He makes tours, travels about, and investigates the health conditions of the Province generally. He makes special inquiry into particular outbreaks of disease, such as cholera, or fever. He turns his attention generally to sanitary objects. He reports, as a rule, upon schemes which are proposed by Municipalities. This may be done by him, but it is now done more by the local Sanitary Board, which has been established of late years. He used to be asked for his opinion. As a matter of fact, in most instances, he is a member of the local Sanitary Board.

7749. Is he also responsible for all vaccination proceedings ?—He is responsible for the vaccination procedure. The Vaccination Department is essentially under him.

7750. Can you tell us what sort of establishment he has under him ?—He has first of all a certain number of Deputy Sanitary Commissioners. Each of these has a circle, and he does, in his own circle, the same kind of work as the Sanitary Commissioner does for the whole Province. He makes reports to the Sanitary Commissioner, and he calls the attention of the local authorities to any defects he sees. He tries to improve registration, and looks after and verifies the vaccinations. He generally gives himself up to sanitary work.

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7751. Again, there is a subordinate establishment, is there not?—Formerly the vaccination establishment had a considerable number of Inspectors of Vaccination, most of whom were Assistant Surgeons, but since the Deputy Sanitary Commissioners have had vaccination put under them, the bulk of those men have been dismissed; they have a certain number of them still, although there are not so many as they were. The Deputy Sanitary Commissioners are supposed to do the work formerly done by them. These men again have under them a large army of vaccinators, and they are supposed to supervise their work, and look after them. It was proposed some years ago that these vaccinators should be utilised as a sort of Health Inspectors, but the great bulk of them are so ignorant that they are practically useless for that purpose.

7752. Were all Superintendents of Vaccination, apart from vaccinators, at one time Assistant Surgeons?—Not all were Assistant Surgeons; a few of them were. Some of them were Hospital Assistants, specially promoted, and a few of them were vaccinators who happened to be more intelligent than the rest, and who eventually became promoted, first to Sub-Inspector, and then to Inspector.

7753. The Sanitary Commissioner has a staff at his disposal, and can issue direct orders to them with regard to vaccination. Supposing any matter comes to his notice in connection with the improvement of the health of a particular district, has he any power to take direct action himself?—No, he has no power to take action, except that he can draw the attention of the local authorities to it. He could not initiate anything.

7754. It would be inconsistent with the system of government in India to have too many authorities to give orders?—It would.

7755. The system is that the Government must look mainly to one officer for executive orders?—That is so. He can recommend and call attention to anything, but he has no power of doing anything.

7756. You mentioned the Inspectors General of Civil Hospitals and the Sanitary Commissioners: are these offices combined in some of the smaller Provinces?—In certain Provinces, in Sind, in the Northern Provinces, and in Burma, and Assam. In Sind and Assam the Administrative Officer has also Military, as well as Civil, Administration.

7757. In the larger Provinces you said something about the Sanitary Commissioner being brought directly under the Director General?—Formerly he was absolutely independent. The Inspector General of Civil Hospitals had no power to issue orders to him, and he was practically an independent officer. His reports came from the Inspector General of Civil Hospitals to the Surgeon General with the Government of India.

7758. Perhaps you will explain what the object of this change is?—He is now subordinate to the Inspector General of Civil Hospitals, but he preserves his power of initiative so far as he gives advice to local bodies. The practical effect is that if he goes to a station, he can inspect the hospitals in addition to doing his sanitary work. In that way you get much more efficient Inspectors of Hospitals, because the Inspector General of Civil Hospitals cannot possibly get through the district under about two years, even if he works very hard all the time. In Bengal the great majority of men do not manage to inspect all their hospitals in the whole course of their five years' tour. He can inspect hospitals, and he keeps the Inspector General of Civil Hospitals fully informed as to the details of sanitary work, and all the projects going on. He can be deputed to make special enquiries for the Inspector General of Civil Hospitals whenever he wants to get any special information, although, as a rule, he is not asked to inspect the work of officers senior to him in the service.

7759. Was not there a reason which you have not given for bringing the Sanitary Commissioner under the Inspector General of Civil Hospitals: so far as you have told us at present, the object would appear to be to destroy the independence of the Sanitary Commissioner, but was that the object?—No, it was to make the sanitary work more efficient.

7760. Was it not the case that the Civil Surgeons being under the Inspector General of Civil Hospitals, and it being impossible to put them under two masters, it was found necessary to place the Sanitary Commissioner under him?—They are really under four masters at present, to a certain extent—at least they are under the Inspector General of Jails and the Inspector General of Civil Hospitals.

7761. But not as regards their sanitary work?—Not their sanitary work; I think that was an element in it.

7762. Was it not the main element?—Possibly. I have never been behind the scenes when the thing was arranged. One reason was that the Sanitary Commissioners were supposed not to do enough inspection.

7763. There is another point: how could a Sanitary Commissioner, before this order was passed, go and give an order to a Civil Surgeon?—He could not give an order.

7764. Now he can?—Yes, as Deputy Inspector General of Civil Hospitals.

7765. You advise the bringing him under the Director General of Civil Hospitals to enable him to give such orders?—Yes.

7766. You were referring just now to the fact that certain of the subordinates of the Sanitary Department were formerly Assistant Surgeons: I understand that the subordinates of the Sanitary Department are not so fully qualified as the Assistant Surgeons?—Not nearly so fully qualified.

7767. Would it be better to go back to the system of having Assistant Surgeons?—It would be an improvement.

7768. Could it be arranged to make Superintendents of Vaccination in time Assistant Surgeons?—It might, but it is a question of expense.

7769. Could it be arranged to have the main bodies of vaccinators as Hospital Assistants?—I think the expense of that would probably be prohibitive, but I think there is one enormous improvement that might be made in the manner of paying vaccinators, which would enable one to get better work out of them, and that is a plan which I introduced myself when I started inoculation in Alwar 28 years ago. I classed my vaccinators in three grades, on 8, 10, and 12 rupees a month, and I re-classified them every year, so that the men in the first grade did their very best work in order to stay there, and the men in subordinate grades did their best work in order to try and get put up higher. The moves were not very many, but there were one or two at the end of each season. The consequence was that all the men worked their very best. In most of the Provinces the vaccinators are paid exactly the same. They have no particular stimulus to exertion.

7770. Supposing you were enabled to get a fair leaven of Hospital Assistants among the vaccinators, would it be a material improvement?—It would be a material improvement.

7771. It would be a great advantage to have people who knew something about disease among the people, would it not?—It would be an immense advantage.

7772. Do you think that it would tend also in the long run to familiarise the people with sanitary improvement, and to render them less opposed to it?—I think it would have that tendency, but we should have to improve the training of our Hospital Assistants in hygiene, and public health. This is being done to a considerable extent.

7773. Perhaps you would explain the system of training which a Hospital Assistant has to undergo?—The Assistant Surgeon is a man who is educated at one of the larger Medical Schools,—Calcutta or Lahore. Those are the only two places where the class of Assistant Surgeons is educated. Of course they are almost all natives. A European can take it if he likes. They educate them up for the M. B. of the Universities of Calcutta and Lahore. They are taught in English. They are intelligent men, and have all passed the First Arts Examination. They can be educated as Medical Students, and they take their L. M. S., or go on to M. B. They are a very superior class, and some make extremely efficient practitioners, excellent surgeons, and good physicians. The Hospital Assistant, on the other hand, was originally what is called a native doctor. He is educated mostly in the vernacular; lectures are delivered by Assistant Surgeons, who are teachers, in the vernacular schools. Lectures are given in the vernacular, and there is a four years' course. It was only a three years' course up to three or four years ago. They are of course an inferior class of practitioners. The greater part of the small hospitals and dispensaries are officered by them. There are two in every native regiment, and there are a large number of them in Military as well as in Civil employment. Some are very good men, some are not good, and some are fairly good: they vary of course. The pay is very small, beginning at 25 rupees a month, and it rises to a maximum of 55 rupees a month, so that you cannot expect anything very great for that.

7774. (*Dr. Ruffer.*)—Are they allowed to practise?—Yes.

7775. (*Mr. Hewett.*)—Upon what work is the Assistant

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Surgeon usually employed?—He is usually employed in charge of a Sub-division, or in charge of a hospital at head-quarters. He is the immediate resident officer, although he does not always reside on the premises.

7776. When you say in charge of a Sub-division, you mean a Sub-division of a District where there is a hospital or dispensary?—Yes.

7777. He is primarily in charge of that dispensary?—Yes; but he is also in medical charge of the Government Officers in the Sub-division.

7778. If he is in head-quarters, he may be in charge of a hospital or dispensary there?—In sub-charge. The Civil Surgeon is responsible for general management.

7779. How are the Hospital Assistants employed?—They are employed in smaller dispensaries, in the District dispensaries as distinguished from Sub-divisional or head-quarter dispensaries. Each District has a considerable number of these small dispensaries, some as many as 20.

7780. Can you tell us roughly what number of Assistant Surgeons and Hospital Assistants there would be in a typical District in this province?—There would be Assistant Surgeons at head-quarters, and one at each Sub-division.

7781. How many Sub-divisions might there be?—They vary.

7782. Take a typical District: would there be four?—I do not know. Perhaps there would be three, or four, or five. In all the other places there would be generally Hospital Assistants in addition to Assistant Surgeons at the head-quarter dispensary. It depends upon the amount of work there is to do; but you may have as many as 20 District Dispensaries in charge of Hospital Assistants.

7783. Can you give us any idea of the proportion of the population which, in your opinion, would, before death, be attended by either a European Medical Officer, or a Civil Assistant Surgeon, or Hospital Assistant?—I should think a comparatively small fraction.

7784. What do you call a small fraction?—I could not give a numerical statement.

7785. Five per cent.?—I doubt it.

7786. You doubt whether it is as large as 5 per cent.—I would rather not commit myself.

7787. I do not want to tie you down in anyway; I only want to know whether you think 5 per cent. too large or too small?—I could give you a statement which bears upon it. Only one-fifth of the population in Bengal is within reasonable distance of a dispensary. I think "reasonable distance" was five miles.

7788. Do these people who do not get the benefit of the advice of men who have been trained in European medicine, resort to practitioners according to the native methods?—They resort to various native practitioners, Vaids, Hakims, and Kabirajes, some of whom are instructed more or less in the traditional methods of sanitary medicine, but a very large proportion of the people are never seen by anybody.

7789. Is there not even now a great deal of prejudice against the use of European medicines?—There is an immense amount of prejudice.

7790. Has that prejudice been rather exaggerated during the course of this plague epidemic?—I certainly think it has been exaggerated, because of the extraordinary lying rumours which these people believe. They have been told over and over again that they were going to be poisoned, and apparently they have believed it. They therefore naturally refuse to take our medicines.

7791. The cause of death of these people who never get attended by a qualified medical officer has to be recorded: how is that done?—The cause of death is put down according to the statement made by the friends of the patient. In the majority of cases, if there is any rise in temperature at all, it is attributed to fever. All cases of pneumonia, acute hepatitis, and anything of that sort, in which there is a rise in the temperature, are put down as fever, and recorded as such.

7792. Is there, in your opinion, any means by which an accurate return could be made?—It would be extremely difficult. There is no doubt that the actual number of deaths registered has been more nearly approximating to the truth of late years, but with regard to the actual cause of death, I do not see how we are to do that, unless we have an enormous increase (which at present is not at all likely) in the number of qualified medical practitioners.

7793. Would any increase which can be contemplated in any reasonable time be inadequate to do this business?—Absolutely inadequate.

7794. There are certain towns which are under the Municipal Acts?—Yes.

7795. Have the majority of these towns Health Officers, or not?—Some of them have Health Officers of their own, but these are only the larger ones, such as Calcutta, Bombay, and Madras. The great majority have no Health Officer, but they are entitled by regulation to the services and advice of the Civil Surgeon in his capacity as such.

7796. How does the Health Officer stand as regards the Municipality: supposing a Civil Surgeon in his capacity of Health Officer makes a recommendation, does the Municipal Committee necessarily carry it out?—Not in the least. He is purely an advisory authority: he has absolutely no power. Of course he can occasionally do a thing, but it depends a great deal upon the personal factor. If he is a popular man in the Municipality and respected, he can get a good deal done, but he has no power of getting it done: he cannot order it to be done.

7797. Supposing that a Municipality which now has the services of a Civil Surgeon as Health Officer were to have a separate Assistant Surgeon, say, appointed to that duty, would there not be a danger that his suggestions would not even be attended to?—I think so.

7798. Can you suggest any means by which the recommendations of a Health Officer might be made efficient?—The only thing I can suggest is that fuller powers should be given to the Sanitary Board of the province.

7799. Kindly describe the Sanitary Board of a Province?—The Sanitary Board consists of a provincial Sanitary Commissioner, and various other members, and in most of the large Provinces there is now a Sanitary Engineer, so that if any project is brought forward, they can have an engineering expert to report upon it, and tell them the probable expense, and generally put them in the right way and avoid mistakes. If they want to have a big project, they have power under the various Acts to impose local taxation; or if it is a very big work which will carry on its advantages to futurity, they can borrow money even on the security of the rates, or as a loan from Government, bearing interest.

7800. When you speak of the rates, what do you refer to?—Local taxation, which is under the control of the Municipal authorities, subject I think to the consent of the Local Government.

7801. Municipal authorities within the Municipal areas. What is the authority outside the Municipal areas?—There are separate boards for rural areas. The Municipalities only deal with urban areas. The Local Boards have functions which are almost identical with those of Municipalities: but they are confined to rural tracts outside big towns.

7802. The whole district would be either a Municipality or a rural area under a Local Board?—Yes.

7803. Do you think that anything could be done to get the reports of the Health Officer brought before the Sanitary Boards?—I think that could easily be done by a simple executive order of the Government.

7804. Would it be possible to arrange that when any competent Health Officer has given a report regarding anything which he considers necessary in the Municipality, a copy should go to the Sanitary Board; and that if the Municipality failed to act upon it, the Sanitary Board could enforce it?—It is a question of administration which I think would be rather beyond my province. I think it might be done.

7805. It could not be done under the law now, but you think it would be a very good thing to have such a power?—Yes, I do.

7806. I was going to ask you with regard to the composition of the Sanitary Board?—The Sanitary Boards might be composed of an officer of approved administrative experience, the Sanitary Commissioner for the Province, and an officer of the Public Works Department, skilled in sanitary engineering. With these officers might be associated one or more non-official members appointed by the Local Government. Every Commissioner of Division in Northern India and Bombay, and possibly District Collectors in Madras, might also be *ex-officio* members of the Board, when dealing with questions connected with their divisions or districts.

7807. The constitution probably differs in different Provinces?—Yes.

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7808. Is it laid down in accordance with these general lines?—Yes, it is generally in accordance with these lines.

7809. Can you give us any statement of the powers which Municipalities have either as regards registration of vital statistics, or any other similar matters?—Various Municipal and Sanitary Acts contain provisions more or less somewhat as follows:—"All Municipalities in the several Provinces are empowered to make rules for the registration of births and deaths. They may regulate the construction of private drains, latrines, cesspools, and may order the closure of the same, if necessary. They may also insist on the cleanliness of private houses and lands, and the removal of noxious vegetation. They may frame rules for the management of markets, slaughter-houses, public bathing places, and burial grounds. They may seize any unwholesome articles of food or drink exposed for sale. They are responsible for the protection from pollution of the water-supply. The rules framed for the above purposes are subject to confirmation, as a rule, by the Government, and notification in the Government Gazettes." Those Acts are more or less permissive.

7810. (*The President.*)—Is sewage included?—I think sewage is not included, because as a matter of fact sewage schemes have only been attempted in one or two of the very big cities.

7811. (*Mr. Hewett.*)—Supposing that there is a high mortality either in a Municipal area, or in an urban area, whose attention is drawn to that fact?—The attention of the Civil Surgeon is supposed to be drawn to it, but I think very often it is not until it gets pretty high. Special attention is not called to it unless he hears that there is any disease in a particular tract, and then he naturally makes enquiries, and looks up the statistics, and in that way discovers it. He would probably go out and inspect and see everything, and suggest what were the proper measures to be taken with a view of checking it.

7812. When you say that the Civil Surgeon's attention is drawn to it, you mean I suppose that his attention is attracted to it by figures?—I think he generally hears of it.

7813. But should his attention not be attracted to it by the figures, if the figures were abnormal?—It might be, but the Civil Surgeon is so busy that I am afraid very often the figures are not very closely scrutinised in his office.

7814. Still it is an important portion of his duty?—It is an important portion of his duty, but he has so many other pressing calls.

7815. Supposing it escaped his attention?—The attention of the Deputy Sanitary Commissioner, or of the Sanitary Commissioner, is more likely to be called to it.

7816. The attention of the Sanitary Commissioner would hardly be likely to be drawn to the mortality of an individual village; would it?—In an ordinary small village, it would not be.

7817. In a group of villages?—It might or might not. If there was a bad epidemic, his attention would certainly be called to it; he would hear about it.

7818. Can you and do you get almost immediate intimation of all outbreaks of cholera?—Yes, I think you do. You may hear of an outbreak in a small village only when it is over, but for all practical purposes in a large outbreak of cholera you get early intimation.

7819. The people are thoroughly conversant with the symptoms of cholera, are they not?—Absolutely. It is one of the few things as to which the statistics are probably accurate.

7820. You get information from responsible persons?—They quite understand all about cholera. They are accustomed to apply at once to get cholera medicines, in which they have great faith.

7821. This report would come from a man who is responsible for dealing with the vital statistics of the village?—Yes.

7822. Do the annual sanitary reports in every province specially deal with such outbreaks?—Yes.

7823. Do you think that it would be possible to ensure that outbreaks of plague should be similarly reported?—In the light of my own experience I should say that it would be extremely doubtful.

7824. Why?—Because people have got it into their heads rightly or wrongly, that if they report these cases, they will be harassed and turned out of their houses, and generally put to inconvenience. They prefer to stay where they are, and, if Providence chooses, die of it.

7825. Do you think that they recognize it at once?—I do not think they would recognise it at first, but they would soon get to recognise it.

7826. The point is this. Is the Government likely to be able to put its finger on the plague at once before it spreads through a village?—I am very much afraid it is not.

7827. Why do you think it is not?—In the first place the people are ignorant. They would not recognise it in the first instance. If they knew there was plague in another village, and a man came from that village, and died, they might then be on the alert and report it. On the other hand they might not; they might say, "If we report it we shall have a cordon put round us, and be turned out of our houses and put to inconvenience." I think in a very great many cases they would simply conceal it, and say nothing about it.

7828. Is it not likely that in the first instance they would call it fever?—Undoubtedly. The cases would be returned as fever in the first instance.

7829. Before the number of cases began to excite the attention of the villagers themselves?—Yes.

7830. So that it would be almost impossible to feel certain whether plague existed in the village or not?—It would be impossible to make certain without actually going and seeing the cases.

7831. There have been great difficulties about the registration of deaths in the Presidency towns, have there not?—There have been difficulties I think everywhere.

7832. Have there not been almost greater difficulties in Presidency towns than in smaller Municipalities?—I think that is so, because there is such an enormous mass of people. In the smaller Municipalities the authorities know the people much better than they can in a large town.

7833. Is it the case that the Governments of Bombay and Bengal are at present trying to devise more efficient registration in Bombay and Calcutta, respectively?—I understand that they are.

7834. It is a matter of great difficulty?—It is a matter of extreme difficulty.

7835. Before this outbreak I think you had studied the question of plague for some time?—Yes, I had studied plague carefully for many years, and taken great interest in it.

7836. Some years ago you gave a popular lecture on plague: I do not propose to take you through it, but perhaps you would state what you consider to be the main cause of the outbreaks of plague?—I think it is stated in the lecture that plague is of disease propagated by a specific germ which springs from a pre-existing germ, and cannot originate *de novo*. This germ is the seed of the disease, and as seed cannot grow without proper soil, so this plague seed cannot flourish unless it finds an environment suited to it, and that environment is made by all these insanitary conditions. It is a disease of filth, a disease of dirt, and a disease of poverty. The whole history of the plague, as far as we know it, shows that to a great extent.

7837. You attach great importance to sanitary improvements?—Sanitary improvement is the one real way of dealing with plague. Of course sanitary improvements are comparatively much better as a preventive than as a cure. You cannot put an insanitary town into a sanitary condition during the course of an epidemic.

7838. Can you tell us whether anything substantial has been done in recent years in India in the way of sanitary improvements?—Enormous progress has been made of late years, especially during the last 10 years.

7839. Have you any details?—I can put in a list of sanitary work which has been done,—drainage and water-supply.

7840. This list comprises larger works only?—It only comprises larger works—drainage works and water-supply works:

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It is as follows :—

List of places in which drainage and water-supply works have been completed.

	Drainage.	Water-supply.
Bengal—		
Burdwan Town	...	December 1884.
Howrah Town	...	February 1896.
Calcutta Town	1888	1870.
Suburbs of do.	...	1891.
Cossipur-Chitpur	...	April 1895.
Dinajpur	1887	...
Jalpaiguri	1896	...
Rangpur	1890	...
Darjeeling	...	1897.
Dacca	...	1878.
Nasirabad	...	1893.
Patna	1894	...
Muzaffarpur	1895	...
Arrah	...	1894.
Bhagalpur	...	1887.
Puri	1895	...
Purulia	...	1894.
Assam—		
Gauhati	...	1887.
Shillong	...	1884.
North-Western Provinces and Oudh—		
Naini Tal Town	...	1892.
Haldwani Town	...	1891.
Dehra Dun Town and Cantonment	...	1896.
Mussoorie Town	...	1895.
Cawnpur Town	...	1894.
Allahabad Town and Cantonment	...	1891.
Lucknow Town and Cantonment	...	1894.
Benares Town	...	1892.
Saharanpore, Rampur and Deoband Rural Circles	1896	...
Muzaffarnagar and Pur Rural Circles	1896	...
Titavi, Shahpur and Kairma Rural Circles	1897	...
Meerut Town	...	1896.
Meerut, Kithore, Baxar and Bahadurgarh Rural Circles	1897	...
Ghaziabad Rural Circles	1895	...
Baghpat and Chaprauli Rural Circles	1897	...
Syana, Khanpur, Ahar, Jahangirabad, Debai and Anupshahar Rural Circles.	1897	...
Dadri and Arnia Rural Circles	1895	...
Dandaur, Jhajhar, Jewar and Sikandrabad Rural Circles	1894	...
Narainpur, Chandaus, Khair, and Hardnaganj Rural Circles	1894	...
Sikandra Rao and Ugsauli Rural Circles	1895	...
Jalesar Rural Circle	1892	...
Sahawar, Aliganj and Marehra Rural Circles	1895	...
Sirhpura and Pateali Rural Circles	1897	...
Nohjhil Rural Circle	1894	...
Muttra, Ol, Rasulpur and Aring Rural Circles	1897	...
Kampil, Kaimganj and Beawar Rural Circles	1895	...
Agra Town	...	1890.
Agra Cantonment	...	1894.
Malpura, Kurauli, and Achnera Rural Circles	1896	...
Punjab—		
Delhi Town	...	1893.
Umballa Town	...	1895.
Simla	1893	1893.
Ludhiana	1893	...
Lahore	...	1881.
Amritsar	1885	...
Dalhousie	...	1894.
Gujranwala	1892	...
Sialkot	1888	...
Rawal Pindi	...	1887.
Murree	...	1894.
Kohat	1892	1893.
Kalka	...	1890.
Jullundur	1891	...
Bunga	1890	...
Abbottabad	...	1892.
Haripur	...	1896.
Gurdaspur and Kalanaur Rural Circles	1894	...
Dunera Rural Circle	...	1894.
Shahgarib, Fatehgarh, Kahnawan and Dehra Nanak Rural Circles	1894	...
Maheshpur Rural Circle	1893	...

	Drainage.	Water-supply.
Central Provinces—		
Nagpur City and Sitabaldi	...	1873.
Nagpur Civil Station, Sadar Bazar	...	1891.
Burhanpur Town	...	1893.
Jubbulpore Town	...	1883.
Raipur Town	...	1893.
Hinganghat Town	...	1885.
Berar—		
Khamgaon Town	...	1885.
Amraoti Town	...	1887.
Amraoti Camp	...	1888.
Buldana Town	...	1892.
Madras—		
Coonoor Municipality	1893	...
Cuddapah	...	1893.
Kumbakonam	1894	1893.
Madura	...	1894.
Madras	...	1872.
Adoni	...	1895.
Tanjore	...	1895.
Dindigul	...	1896.
Trichinopoly	...	1896.
Conjeeveram	...	1897.
Kurnool	...	1897.
Burma—		
Rangoon	...	...
Bombay—		
Bombay Town	Commenced in 1879 but are still incomplete.	Partially completed in 1896.
Jalgaon Town	...	1878.
Thana Town	...	1881.
Bandra Town	...	1896.
Alibag Town	...	1876.
Roha-Ashtami Town	...	1884.
Panvel Town	...	1895.
Talegaon Dobhada Town	...	1887.
Sholapur Town	...	1881.
Pandharpur Town	1882	1879.
Satara Town	...	1886.
Ratnagiri Town	...	1881.
Rajapur Town	...	1878.
Hubli Town	...	1894.
Ahmedabad Town	1893	1891.
Karachi Town	1895	1884.
Hyderabad Town	...	1879.
Sukkur Town	...	1895.
Yeola Town	...	1872.
Pen Town	...	1876.
Karad Town	...	1872.
Vengurla Town	...	1878.

In 1896-97 the proportion of income spent on sanitary works in each province was as follows:—

	By Municipalities.	By Local Boards.	Total.
Madras	26 per cent	7 per cent.	14 per cent.
Bombay	21 „	3 „	16 „
Bengal	32 „	1 „	19 „
North-Western Provinces and Oudh	34 „	3 „	22 „
Punjab	18 „	2 „	11 „
Central Provinces	29 „	2 „	19 „
Upper Burma	13 „	0 „	13 „
Lower Burma	16 „	0 „	16 „
Assam	37 „	4 „	10 „
Berar	23 „	0 „	23 „
Coorg	27 „	0 „	27 „

7841. What are the improvements which have been undertaken in the rural areas?—There have been attempts in the way of cleaning tanks, and improving wells, and getting away redundant vegetation, and things of that sort. Occasionally I think there have been improvements in the way of trying to induce the people to resort to latrines, instead of the old plan of making every court-yard a latrine.

7842. You have had experience as a doctor, I think, over large areas of India?—Yes.

7843. Will you tell us what Provinces you have had experience in?—I have been in Rajputana, in Central India, in Bengal, and in the Punjab; and I have been all over India in various capacities.

7844. You have practised in this town, I believe, for a number of years?—I practised in Calcutta for some 12 years.

7845. Had you ever seen plague before this outbreak?—I had never seen plague, or anything approaching it.

7846. Have you ever seen a form of bubonic fever at all resembling it?—Not what I have called bubonic fever. I have seen cases of fever with enlarged glands, but whether they were due to fever, or whether fever was due to the enlarged glands, I am not prepared to say. I have seen very few cases. They were all extremely amenable to treatment. I have never known a case fatal.

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7847. Have you seen these in other parts of India, besides Calcutta?—I have seen them elsewhere.

7848. Have you ever seen a case of mahamari?—Though I have never seen a case, I know about it, and by its description it appears to be true plague.

7849. Some years ago you were rather apprehensive lest it should come into Calcutta from the Hills, were you not?—I thought it quite possible.

7850. Do you think there is any evidence to show that for the last 30 years or more there has ever been any mahamari in the plains of India?—Except in Rajputana—I suppose it is more than 30 years since the last out-break—I understand it is 60 years since the last out-break. I have never known it. I suggested that as a sort of warning to the inhabitants of Calcutta to set their houses in order. As a matter of theory I cannot see why a Kumaun coolie should carry plague: they are not people who travel much.

7851. You do not think they move about much?—I do not think so.

7852. Can you explain the mildness of the outbreak of plague in Calcutta?—No, I do not think I could give any theory with regard to it. It is one of the most inexplicable things I know. I do not profess to be able to account for it.

7853. You have made reports on various plague measures to the Government, but you have had no executive management?—Beyond seeing cases when walking through the wards of the hospitals, I have had no clinical, or bacteriological, or pathological, experience of plague.

7854. Have any facts come to your notice with regard to the efficacy or otherwise of evacuation?—A number of facts have come to my observation on both sides. I think evacuation is one of the most excellent methods, provided you can carry it out effectively. Evacuation is quite possible in small areas, but when once plague gets into a big city, you cannot evacuate that. An attempt at evacuation would simply lead to the concealment of cases, and the disease would be spread unknown in all directions.

7855. During your inspections have you paid particular attention to the matter of disinfection?—I have seen a number of disinfecting gangs at work. I have made enquiries, and I have read the notes on the different uses of the different disinfectants. I have come to the conclusion that effective disinfection is extremely difficult, especially in native houses.

7856. For what reason?—Because the people have frequently got odd crannies, projecting beams, and tiles which are unsealed, and cracks in the walls, rat-holes, and one thing and another. It is very possible to apparently have disinfected and swabbed up the whole place, and still to have left some spot untouched by your disinfecting solution.

7857. Would you regard disinfection which did not touch the roof as complete and effective?—I think it would be desirable to have the roof disinfected, as well as the other parts of the house, although it is the general belief that plague adheres to the ground.

7858. Do you think that it would be necessary?—Yes, I think so, for complete disinfection.

7859. Can you tell us who has laid down the rules with regard to disinfection?—The rules appear to me to vary very much in different provinces and in different districts of the same province, and to have been apparently left to a considerable extent to discretion. The Government, in its original notification about plague, told everybody that the best disinfectant was a solution of perchloride of mercury—1 in 1,000; but I find they have used all sorts of things, some of which, I think, are rather doubtful.

7860. Were you satisfied that they were all effective disinfectants?—I believe some of them are effective. They are all more or less disinfectants, but I think a great many of them require to be used of much greater strength than is claimed for them by their inventor.

7861. Do you think that it would be advantageous to lay down, if possible, some authoritative rules as to disinfection?—I think it would be a great advantage; but the Government of India, so far as they could, did lay down these rules at the beginning, and gave information as to how the solution was to be prepared.

7862. I understand you to be of opinion that although this general direction was given, and although the local authorities are using their best endeavours in the matter of disinfection, disinfection is not so efficient as it might be on account of the different systems adopted, and on account of some of the disinfectants not being effective?—Yes, and I have another reason why you get inefficient disinfection. You have to work through human agency. The people actually engaged in the work are mostly coolies, and unless they are constantly supervised, they are very apt (as they do not understand the importance) to shirk the work, and do it in a perfunctory way. I think very many houses supposed to have been disinfected have never really been done.

7863. Have the people in your experience shewn great disinclination to go to the Government hospitals when suffering from plague?—I was told in Bombay that they were going very freely. I cannot speak as to the people generally. I know that the plague hospitals during my first visit were pretty full, and the people seemed contented enough.

7864. You have not had much experience of this disinclination?—I have not had experience, but I know as a matter of hearsay that a large number did object to being taken to the hospital.

7865. Have you had any experience of moribund patients being taken to the hospital?—I have.

7866. Do you consider it humane to take moribund patients to hospital?—No. I think when a man is absolutely moribund, he should be left to die where he is.

7867. What would you do with such a patient?—I should try to get the other people to evacuate the house, with the exception of one or two people who would be left to nurse him. I should put him in the best room available, and under the best sanitary conditions possible. I should try to evacuate the neighbouring houses. I saw a case the other day at Belgaum. Two cases were reported. I found that these two cases were to be left where they were until they died, or recovered, and that no attempt was to be made to empty the two adjacent houses, one on each side. There seemed clear evidence that the two cases I saw had been infected from the house next door to one where there was a case a fortnight before. I recommended that these two adjacent houses should be immediately evacuated, if possible. I thought there was distinct risk in keeping them occupied.

7868. I think you have a chart, which you would like to put in, showing how second outbreaks have occurred at different places?—Yes, I wish to put these charts* in, as showing how, in spite of the most enormous exertions, and the most absolute devotion on the part of the plague authorities, in spite of the experience which they have gone through in the original outbreak, they all seemed powerless to prevent recrudescence, which, in the majority of cases, is worse than the original outbreak. I sent a note to the Government sometime ago. I bore absolute testimony to the extraordinary devotion of the plague officials in every place I went to, but I expressed an opinion founded on the course of the epidemic in Hong Kong, that it was not possible to stamp out plague when it once got severe hold of a big city, and that it ran its course, and that in spite of the experience gained during the first outbreak, and in spite of the people having got accustomed to the measures, it was still not possible to prevent a recrudescence. This chart shows Bombay city, Poona city, Karachi city, and Hubli, and Belguam; I have gone carefully through the returns, and the thing practically applies to almost every district in the whole of India, except a few which have just begun their first outbreak,—that they always seemed to have a second outbreak which is much worse than the first.

7869. (*The President.*)—That applies to the cities?—To the cities. The same thing practically applies to every district in the Bombay Presidency.

7870. (*Mr. Hewett.*)—I have a few questions with regard to inoculation which I want to ask you. First of all, I understand that you were inoculated yourself?—I was.

7871. I will read out a description of your state as given by Dr. Lawrie, and ask you whether it corresponds exactly to your case:—"While these proposals were under consideration, the Director General visited Hyderabad. The Director General had been inoculated three days previously by M. Haffkine, and he was suffering from fever and erythema, due, in my opinion, to septic blood poisoning. He was laid up all the time he stayed here (two days), and, as a consequence, which requires no explanation, my proposals fell to the ground." Does that

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* See Appendix No. XXIII in this Volume.

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accurately represent the case ?—That statement is extremely exaggerated. I was inoculated by Professor Haffkine and I had the usual reaction which made me uncomfortable for the next day. The day after that I did a heavy day's work and sat writing for hours and hours with my arm hanging down, which seemed to me to have the effect of irritating it, and I had a very bad local affection, erythema of the arm, for a few days. I travelled to Hyderabad with it. I did all my work at Hyderabad, except one day when I was going to inspect Dr. Lawrie's institutions, and I should have inspected them, had he not peremptorily ordered me to bed. I spent one day in bed. I got up and went to a dinner party. I drove over to Secunderabad. The day after I got back to Bombay I did an enormous amount of work with the Plague Commission. There was local irritation, and it was extremely painful, but Professor Haffkine told me that a case like mine did not happen once in a thousand inoculations. I had no fever at all in Hyderabad.

7872. You have entered in your précis of evidence certain notes of the results of inoculation. We have had figures put forward by M. Haffkine and other people, but I do not propose to take you through them, because you have no direct knowledge of them ?—Except in the case of Undhera.

7873. You went to the village of Undhera ?—Yes.

7874. Did you go there when the inoculations were taking place, or did you go there to test the results ?—We were testing the results.

7875. I think Dr. Bannerman told us that they made a census at the time: that an Assistant Surgeon remained in the village, and ticked people off on the register ?—So I understood.

7876. When you went there you investigated this register ?—We saw the register, and that was the thing we were actually engaged in. We took many hours. We took the families in which plague had occurred. We went round to the houses occupied by each of these families, and we called over the names, and either saw every member of the family who was still alive, or had it explained to us how and when he died, and of what disease. There were various deaths due to causes other than plague among the inoculated. We saw all the people who were alive. We went to each separate house, and we called out the roll of the names, and they were answered to. I was very much interested in them. I had not at the time formed any definite opinion as to the advantages of inoculation, and I was extremely anxious to avoid all source of fallacy, and so far as I could see, the cases seemed absolutely clear. It was evident that inoculation, although not an absolute protection, was so to a very considerable degree.

7877. Are you satisfied that the experiment, as made there, was so made as to exclude all possibility of error in the figures ?—I cannot see any source of error in the Undhera figures.

7878. Are the results, in your opinion, as reliable as they would be had you inoculated persons under your immediate eye ?—I think so.

7879. You also refer to some facts regarding the Khoja community. I understand it is your intention, if possible, to test the period of immunity by examining the results of the inoculation of this community ?—I have promised Professor Haffkine that, if I can arrange it, I will go to Bombay later on and go through the records with him of his inoculations in the Khoja community.

7880. Will you kindly communicate the results to us later on ?—I shall be very pleased to do so. I may say in a chance way, that I am not at all sure that we shall be able to get any definite results, because I constantly found in the register at Belgaum such entries as these, "David, Belgaum," "Elizabeth, Belgaum." You cannot trace people there in that way. I will send you whatever information I can get.

7881. Do you think that the people will ever consent to be inoculated on a large scale before there is an outbreak of plague among them ?—I do not think so. You have only to look at the way in which they neglected vaccination. They admit the effectiveness of vaccination, but they are apt to neglect it.

7882. Supposing there is an outbreak of plague, would it in your opinion, be feasible to rely entirely upon inoculation ?—Absolutely impossible. Although I believe inoculation to be a valuable thing and a great help, I have always said that it can never be anything but an auxiliary to sanitary measures. It is physically impossible for you to noculate the whole of India.

7883. At a sufficiently rapid rate ?—It would take years and years to do it. You could not do it with the possible agency you have at your command. It would take 300 men doing 400 each day to work out 120,000 doses a day.

7884. You have been round the places where the inoculations took place, and you have been in communication with officers who have been inoculating: have you ever received from any person engaged in inoculation any complaint that the fluid was not sterile ?—I have not heard that. I have heard that an occasional bottle had been found to be bad. I have on two occasions seen a bad bottle.

7885. Have you ever heard that it was not sterile ?—Not until I saw it in the paper the other day.

7886. You have heard of instances in which it has been putrid ?—Yes, I have known two instances. My own nose bore testimony to the fact.

7887. That, I suppose, is due to carelessness in putting the bottle up ?—It is due to carelessness, an imperfect cork, a bubble of air in the wax or some such thing.

7888. The standard dose for an adult is 2½ c. c. ?—That is the theoretical standard.

7889. Are the bottles usually sent out with that dose ?—They vary considerably, and sometimes it is as much as three or four times the standard. It makes a large bulk of fluid to inject, and it takes much longer to do. It is a physical strain upon the Medical Officer doing the work. It is extremely desirable that some plan should be advised of standardising.

7890. You are strongly in favour of doing this ?—Yes ; I have myself on more than one occasion brought Professor Haffkine's attention to it.

7891. Professor Haffkine told us that he used mutton broth for cultivation ?—Yes.

7892. Is there any portion of the community in India which would object to be inoculated on the ground that mutton broth was used ?—The only people who could possibly object on religious grounds are the Jains.

7893. Do they object ?—Yes, they object to anything which involves the death of any animal.

7894. They are numerous in the Bombay Presidency, I think ?—Yes.

7895. Would it not be a good thing, if possible, to try and devise some vegetable medium ?—I suggested papaya. It struck me that that might possibly do. I am not a chemist, but I suggested it to Dr. Warden when I sent him over to Bombay.

7896. Is any control exercised over Professor Haffkine in sending out these bottles ?—No; he has his laboratory, and does it on his own responsibility.

7897. The Government pays his salary ?—Yes, the Government, and partly the Bombay Municipality, supply all the material he wants.

7898. Would it not be desirable to have some kind of control over him ?—I do not know. It seems to me that he ought to be the best judge of what is necessary. I am not a skilled bacteriologist. I should be very sorry to have to put my opinion against his. I do not see who else is to control it.

7899. You think that putrid bottles may do a great deal of harm ?—Yes; but they are probably not putrid when they are issued. I think they get putrid afterwards. They have probably got some putrefactive element in them which you cannot recognise in the bottle until you open it as being putrid.

7900. Have you any bacteriological work going on under your control ?—We have made some small beginnings. There is a small laboratory here which was under Dr. D. D. Cunningham, and there is a laboratory at Agra. We have recently had three Military Officers told off for general sanitary and bacteriological work in connection with the Punjab and Bengal Commands; but they have got very small and insufficient laboratories. Of course, there is Haffkine's laboratory in Bombay; and there is a laboratory in Hyderabad, and one in Mysore.

7901. Would it be possible and desirable to increase the number ?—It would be extremely advisable. I have been urging it for many years.

7902. Have you Medical Officers in the Indian Medical Service qualified to take charge of the laboratories ?—We have many officers who have the making of excellent bacteriologists, who have gone through very excellent training at Netley, and who could easily take up the work, and develope

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in time into skilled bacteriologists. Bacteriology is a very special subject, and it takes a long time before a man is thoroughly skilled in it.

7903. What do these officers do on their arrival from Netley?—The Indian Medical Service is primarily a Military Medical Service. All the officers belong to the Military Department, although two-thirds are meant for civil work. The Civil Government is bound to supply a certain number under definite conditions in the event of the Military Department requiring them for mobilisation. Every officer belonging to the Military Department has to do two years' military duty before he is allowed to be lent to the Civil Department,—that is, in order that he may be available if called upon for war. He will come to them with a knowledge of work in Military Hospitals, and with a knowledge of military discipline.

7904. Then an officer who has made a speciality of bacteriology would, during his first two years of residence in India, have to do military duty?—Yes, they all have to do military duty except under very exceptional circumstances. There is a clause in the Medical Regulations to exempt Officers for special reasons. It is not often carried out, because the Principal Medical Officer on the military side objects to this. He says that if an Officer goes straight to Civil work he does not learn the discipline and routine of a Military Hospital, and that he is practically useless as a military reserve. From that point of view, I think he is right. From the other point of view a man has no opportunity of carrying out bacteriological experiments, and he gets rusty. We have lots of young men who could very soon rub off that rust, and I have devised a scheme lately, by which we hope to have one man at least every year who will have gone through a thorough course under Professor Wright at Netley. That in time would give us a series of trained men. We have got the material, but it is not available for immediate use.

7905. I understand that you have had at different times Medical Officers employed on special enquiries, such as Dr. Ross and Dr. Rogers. What duties were they employed in?—Dr. Ross was employed in preparing a history of the malaria parasite. He has discovered a similar parasite in birds, and his results have been accepted by Laveran Cressi, and high authorities on the subject in Europe. The results appear to be very valuable from a scientific point of view; but whether they will lead to any practical results is another matter. Dr. Rogers was employed in investigating the cause of Kálá azár, a fever which has been creating great havoc in Assam of late years.

7906. I suppose investigations of this sort would probably be better carried out if you had a bacteriological institute under your control?—Yes. As a matter of fact Dr. Ross has great natural proclivity for work of this kind. He has been working as an amateur ever since he came into the service. He at first fell into a great number of mistakes, as all amateurs must do. He found out that he had been wrong, and he said so. He is now an extremely good man to the best of my knowledge and belief. I am not a specialist myself; I have to accept the judgment of other people.

7907. (*Mr. Cumine.*)—With regard to the Jains, is the word "Jain" used correctly in Bombay or is it used to include people who do not belong to the Jains?—That I cannot tell you. I always understood that a Jain was a person who went about with a piece of cloth over his mouth to prevent his catching insects, but a great many in Bombay do not. Whether they are real Jains or not, I do not know.

7908. With regard to this chart which you have put in the plague germ remained alive in Bombay throughout, it never died out?—It never died out absolutely; they were having cases all the time. They got down to 5 cases on the 13th of July 1897.

7909. In large towns like Poona, Surat, Sholapur, Nasik, did they get rid of the epidemic?—Poona got rid of it for a time, but there was a bad recrudescence.

7910. I mean plague ceased for a time there?—Yes; these charts are for the cities not the districts, but the districts practically showed the same curves.

7911. With regard to the second outbreak at Poona, Surat Sholapur and Nasik, do you know whether that was necessarily due to recrudescence of the original germ which caused the first outbreak, or whether it may not have been due to the importation of a germ from somewhere else?—It is quite possible it may have been an importation.

7912. You mentioned many of the duties of the Civil Surgeon; there is one more I think, *viz.*, that he has to inspect factories?—Yes, he has to inspect them when there are factories in his district. Various Civil Surgeons have various extra duties. The Civil Surgeon of the 24 Pargannahs, for instance, has charge of a lot of the officers of the Indian Marine; he has also medical inspection of emigrants; he has got all sorts of additional duties of that kind. The Civil Surgeon of Ranchi has got to pass an enormous number of coolies who are going as emigrants to Assam. The Civil Surgeon, in fact, has to do whatever duty lies to his hand.

7913. Do you think that a man who has so much to do already could manage an outbreak of plague in villages distant from the head-quarters station?—Not without neglecting his work in the station. He would have to neglect his work in the jail and the Inspector General of Jails would not be at all pleased with him.

7914. Therefore the management of an outbreak of plague in the villages of the district must be left to the Administrative Officer on the spot?—It must practically. The Civil Surgeon would, no doubt, help him by all the means in his power. He could go out now and then and give advice and do what was possible, but he could not leave the station for more than a short time.

7915. Is the staff of doctors in India sufficiently strong to enable the Government to send doctors to take charge of, say, 50 or 60 infected villages?—We do the best we can. We have at the present moment 31 Commissioned Officers on special plague duty. We have had to import a large number of people from England. We have actually engaged something like 51 local men who happened to be available, and we have also asked some 60 or 70 more if they would take official plague duty and they refused. I think we got 51, as far as I recollect. With these 51 men and the Medical Officers specially deputed to plague duty and the men got out by the Secretary of State, we have done the best we can so far. At times the pressure has been extremely heavy, and it has not been possible to a large extent to deal with plague in the villages.

7916. But in an outbreak of plague amongst a lot of villages, the chief duties to be performed are, as a matter of fact, administrative duties, are they not, rather than healing ones?—Yes, the healing is a secondary matter: I do not think, as a matter of fact, that healing makes much difference. You want to try and get rid of it by administrative measures.

7917. I think you said the Government had prescribed perchloride of mercury in a certain proportion as the best disinfectant?—Yes.

7918. I suppose that was advised by some scientific authority?—Yes, I think so: I think it is based on the manuals of hygiene, and it has also been based upon experiments. A number of experiments were tried, and it was found the bacillus died more certainly under a perchloride of mercury solution than anything else.

7919. I suppose the returns of deaths in villages take a long time to get to the Deputy Sanitary Commissioner, do not they?—Yes, I think they probably do.

7920. In a small village the plague would have laid good hold upon the people before the Deputy Sanitary Commissioner had time to see from the figures that it was prevalent?—I think probably so, because if he has to get his information from the figures it is manifest that a number of plague deaths must have occurred before they showed themselves in the figures, and therefore the plague must have got a hold.

7921. The Deputy Sanitary Commissioners in the course of their tours inspect towns and large villages and send a report to the Collector of such sanitary defects as they observe, do they not?—Yes.

7922. I suppose in an ordinary village the sanitary defects will include such things as cattle being tied up in the house, and heaps of manure being kept close to the houses?—Those things are so universal that I do not think they are ever considered defects. It is a root habit of the people to do those things.

7923. If there is a stream flowing past the village the people generally wash their clothes in the same place that they get their drinking water from, do they not?—Yes, they wash their clothes in it and micturate in it; they are not particular.

7924. If an attempt were made to put these defects right it would create a considerable amount of popular discontent, would it not?—Undoubtedly.

7925. So that the question is not merely a sanitary one?—Not at all; it is largely a political one, and that is one of our main difficulties. One is want of money and the second is the opposition, prejudices and callousness of the people. They do not like being interefered with at all.

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7926. I suppose it is not so much information that a town is in an insanitary state that is wanting, because the unscientific district authorities can see that for themselves, but the main thing is want of money to put things right, is it not?—Yes, and the power to put things right, and the power to induce the people to accept them. If they have to be taxed extra to pay for improvements they resent it still more.

7927. Before the existing Sanitary Boards there come projects of water-supplies and drainage, and that sort of thing, so that under the present circumstances it is only to those Municipalities which are going to do something that the attention of the Sanitary Boards is attracted?—Mainly.

7928. The Sanitary Board's attention is not specially directed to Municipalities that are not doing anything in the sanitary way, or to villages, is it?—I think not. Of course the number of villages is legion.

7929. I think you mentioned a case in Belgaum, where you thought that two neighbouring houses should have been evacuated?—Yes.

7930. But I think that before that in your evidence you had spoken of the concealment which the people resort to from fear of being evacuated?—Yes. I tried to persuade the people to leave, but if they insisted and said they would not leave, I should have left them where they were.

7931. (*Prof. Wright.*)—Do you select the subordinate Sanitary Commissioners?—That is a very moot point. The Sanitary Commissioner himself is nominated by the Local Government and that nomination has to be approved by the Government of India. If the Government of India consider that he is not fit for the appointment which, of course, they are not likely to do, they have the right to suggest a man from another Province, but they cannot suggest another man from the same Province because the Local Government is supposed to be the best judge of the particular appointment its own officers are suitable for.

7932. What guarantee have you that the Local Government will consider the bacteriological and sanitary qualifications of the officer whom they nominate?—I have no guarantee; they can nominate anybody they like.

7933. Would you think the fact that a man had not sanitary experience and bacteriological knowledge a sufficient ground for objecting to his appointment?—I should not have done so up till now, because as a matter of fact no Sanitary Commissioner has ever had a laboratory, and he has not at this moment.

7934. A Sanitary Commissioner then does not necessarily possess more than bacteriological knowledge than his fellows?—That is so. He may or may not. I was once Sanitary Commissioner for Bengal, and I knew nothing about bacteriology except by reading about it.

7935. Supposing the Sanitary Commissioner wants to get advice on bacteriology, where can he turn for that advice?—Hitherto in Calcutta he has been able to ask Dr. Cunningham. Dr. Cunningham was assistant to me and he had a laboratory, and the Sanitary Commissioner or anybody else who wanted any information on scientific matters was at liberty to apply to him. I do not know that he had a right to ask him, but he could have got a report, if Dr. Cunningham had been unwilling to furnish it, by asking his own Inspector General of Civil Hospitals to ask the Director General, and the Director General would have issued orders to Dr. Cunningham to give the information, if he thought it desirable in the interests of the service.

7936. In such places as Calcutta, Bombay and Madras, have you a voice in the appointment of the Medical Officers of Health?—None whatever.

7937. Who appoints this Medical Officer?—The Municipality appoint the Health Officer.

7938. Has the Sanitary Commissioner of Bengal any *locus standi* as regards the city of Calcutta?—It is outside the jurisdiction. The city of Calcutta has a Health Officer of its own, and the Sanitary Commissioner does not interfere.

7939. I understand that in Bombay and Madras the Medical Officer of Health is an officer of the Indian Medical Service?—He is, as it happens, but he is not necessarily so.

7940. Do Indian Medical Officers enter as candidates along with other outsiders?—I think so.

7941. And it is a question of whether he is elected or not?—Yes; if he is elected, the local authority ask for him, and he is lent to them.

7942. Supposing the Medical Officer has proved himself to be incompetent, have you any power to remove him?—No, I have no power of initiative at all; it would have to come from the Local Government. If I knew a man to be absolutely incompetent I might move the Government of India to move the Local Government to do something, but it would depend very much on what the Local Government thought of the particular officer. They might agree or they might disagree. If they disagreed and said they considered the officer was quite competent I do not think the Government of India would have any power to do anything.

7943. With regard to the code of regulations for disinfection, have you any laboratory in which such questions could be worked out, or have you any officer to whom you could depute such a task?—We have at this present moment Dr. Cunningham's laboratory, but we have had no successor appointed in his place, except Dr. Ross, who is on special duty, and I do not know that he would be an authority on disinfectants.

7944. At present you have no authority to turn to for a code of disinfectants?—No. A number of experiments have been actually made on the different disinfectants by Mr. Hankin, and in Prof. Haffkine's laboratory. We have the reports of those experiments.

7945. But there is no professional adviser?—There is no professional adviser on scientific matters. Dr. Cunningham was professional adviser, but he retired last year.

7946. (*The President.*)—Is the office abolished?—No, it is not abolished, but we do not happen to have any particular officer who seemed to me to be so thoroughly qualified as to make me recommend him. I am now looking about and waiting till I find a man suitable for the post. We practically filled it up by appointing Major Ross, but he was attached for the particular purpose of investigating the problem of the malarial parasite.

7947. (*Prof. Wright.*)—You say there are Sanitary Commissioners in the army also?—We have three bacteriologists.

7948. Had you to advise the Government in the appointment of these men?—No, I had nothing to do with that; that was done by the Principal Medical Officer, India, and I was Principal Medical Officer of the Punjab Command. That being a military question, did not come to the Director-General at all, it was settled by the Principal Medical Officer on the military side.

7949. But as Director-General have you to deal only with the Civil medical matters?—Yes.

7950. As Sanitary Commissioner with the Government of India have not you also to deal with the health of the troops?—I have to deal with any question which is put to me, but I have no right to interfere with the Principal Medical Officer.

7951. Not even in matters of sanitation?—Of course, if I saw at the time anything which seemed to me to be very wrong, I would call the attention of the Government of India to it, and if they liked they would call the attention of the military authorities to it.

7952. But it is not your office?—No.

7953. Do not you think you keep a number of men from entering the Indian Medical Service by the fact that they have to perform military service when their inclinations are towards civil work?—I do not think so. We have always extremely good men. Those men who do not like military life apply for the civil side, and practically in the great majority of cases remain in the civil side for the rest of their lives. The other day we had to take 55 men from the civil side and hand them over to the military for the purpose of the frontier campaigns. But they have all reverted to civil duty now. As a rule we find they are very willing to go. There are a large number of candidates, but we do not ask for candidates, we take them.

7954. Do not you find that the Sanitary Cmmissioner's arrangements are dislocated when so many Civil Surgeons are taken for military duty?—Of course we try as far as possible not to take men from special work, we generally take them from the smaller stations and put Assistant Surgeons in place of them. I think two of the Bengal Deputy Sanitary Commissioners were sent, as a matter of fact. Of course it dislocates the arrangements to a considerable extent.

7955. Are the local Sanitary Boards altogether independent of you?—Absolutely.

7956. What provision is taken for seeing that the medical authority has weight on these Boards?—He must trust to his own personal influence.

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7957. I understand that when it comes to voting the medical man on these Boards would be out-numbered?—Yes, considerably. If the other people on the Board do not agree with him, as I have already said, he has no power of compelling them to adopt his views. There is a member of the Civil Government, the Sanitary Commissioner *ex-officio*, the Civil Surgeon—the Civil Surgeon is not on the provincial Boards, but the Inspector General of Civil Hospitals is a member of some of them—the Sanitary Engineer and generally one or two natives appointed by Government.

7958. Do the Sanitary Boards hold many sittings: are they active?—They do a good deal of work without holding formal sittings. I remember noting the other day that one Sanitary Board had only met twice in the course of a year, but although that was so, they had done a lot of work apparently by circulating the papers, and they also sent in a number of schemes.

7959. Supposing plague broke out in any district, has the Sanitary Board to advise as to the means of disinfection?—Theoretically it would be responsible I should think, but practically, I believe, it is left to the Civil Surgeon to suggest what he thinks best, and the district authorities to the best of their ability.

7960. You say that it is proposed now to put the Sanitary Commissioner under the Inspector-General of Civil Hospitals?—Yes.

7961. Do you think that a retrograde step?—From one point of view it is, perhaps, but from the point of view of practical administration, I think it is not; I think it is the other way; I think it is an advantage, because he still retains his initiative as a special Commissioner. The two ought to work in harmony together. He is able to bring things to the notice of the Inspector General of Civil Hospitals, and the Inspector General of Civil Hospitals is able to depute him to make special enquiries. The general result will be to increase efficiency, I think. From a theoretical point of view, the Sanitary Commissioner probably knows more of the details of sanitary work than the Inspector General of Civil Hospitals, especially if he has never occupied any special sanitary appointment himself, but I do not think that clashes, because the Sanitary Commissioner, as far as his sanitary advice goes, is practically independent of the Inspector-General of Civil Hospitals. He has not lost his power of initiating projects, and things of that sort, or calling the attention of Local and District Boards to what is necessary.

7962. I understand the Civil Surgeon is under the Inspector General of Civil Hospitals so far as a certain part of his duty is concerned?—Yes, all his medical duties are supposed to be under him, but with regard to his duties in connection with the district jail he is under the Inspector General of Jails, who is practically an independent officer.

7963. Do you see any objection to subordinating the Civil Surgeon also to a Sanitary Authority?—He is now, in a way, under the Sanitary Authority. The Sanitary Commissioner has been made the Deputy Inspector General of Civil Hospitals, and therefore can convey orders to the Civil Surgeons.

7964. Could the Civil Surgeon not be put directly under a Sanitary Commissioner with regard to his sanitary duties?—You have this trouble, that the Sanitary Commissioner now deliberately chosen is a junior officer, because he is supposed to be much more active, and there is a great difficulty in putting a senior officer under the orders of junior officers, especially in the Military service.

7965. Could you get over that by putting the Civil Surgeon under the Sanitary Board of the province?—Of course the Sanitary Board has medical representatives on it, but it has a number of lay persons as well, and the view of the Sanitary Board might or might not commend itself to the Civil Surgeon. It would give him an additional master and make it more difficult for him to carry on his work.

7966. Could the Civil Surgeon act in sanitary matters directly under you as Sanitary Commissioner for the Government of India?—No, because each provincial service is practically independent of the Government of India.

7967. When an epidemic breaks out and an additional staff is required to deal with it, is there any means of supplying that staff?—Yes. In the first instance, the Inspector-General of Civil Hospitals makes all the arrangements he can. If he finds he is not able to cope with it he telegraphs to the Director General saying he wants so many more officers. The Director General then prepares to get the officers, he gets them sometimes from the spare officers. If he has any spare officers available he sends them, if he has not he goes to the Principal Medical Officer on the military side and asks him to lend him some officers. He can usually lend a considerable number of officers by doubling up appointments, because in a military station there may be three or four regiments each of which has a medical officer, and in time of peace one medical officer at a pinch could do the work of two or three. He can, therefore, usually spare some officers, and the Principal Medical Officer did come to our assistance, and gave us a large number at the beginning of this outbreak for temporary plague duty.

7968. Who naturally takes command of the proceedings which are adopted with a view to checking an epidemic?—The Civil Surgeon in his own district, and the Sanitary Commissioner in the province. The Sanitary Commissioner exercises a general supervision, but the actual carrying out of the details mainly rests with the Civil Surgeon as a rule. During this outbreak of plague it has been found that the work has been so engrossing that the Civil Surgeon could not do it in addition to his ordinary duties, and therefore they have adopted the plan of sending a special plague officer and leaving the Civil Surgeon free to do his ordinary work.

7969. Why is the special plague officer not a medical man in all cases?—He very often is a medical man, but one reason for his sometimes not being so is that we have not a sufficiency of medical men. We have had a tremendous additional strain upon us for the last three years; we have had plague, we have had famine, and we have had war. Leave has been practically closed more or less for three or four years, and we are now trying to give furlough to the officers, who want it very badly. The consequence is we are rather short. At this present moment we have 31 commissioned officers on special plague duty.

7970. Do you think it advisable to employ laymen as Plague Commissioners?—It depends upon the work you give them to do. I think, myself it is a great waste of power to send a medical officer to pull off tiles and supervise disinfecting gangs, and build huts in camp. I do not think that is his work. He ought to be dealing with the medical aspects of the case. You can get all the other work done by Staff Corps officers and Civil officers just as well, and you do not waste your power.

7971. Are you satisfied with the disinfection as you have seen it done by the Staff Corps officers?—The very best disinfection I have seen done was in Bombay, under the supervision of some Staff Corps officers.

7972. Have you also seen some bad disinfection done?—Yes, both by Staff Corps officers and by other people. I think a great deal of the disinfection is done in an extremely perfunctory way, because you have to deal with native agency who do not understand the importance of it, and who will take an opportunity of shirking their work if they can.

7973. Do you then not think the laymen do the disinfecting work worse than the doctors?—They have to be carefully instructed by a doctor in the first instance how it has to be done, but once they have learned it I think you may teach them to be very good disinfectors.

7974. What precaution has been taken to see that these laymen who are sent down are instructed in whatever is necessary?—They are put through a rude course of instruction on the spot, and they do the work to the best of their ability.

7975. Who is the instructor?—The instructor in the first instance may be the Medical officer, or it may be a Staff Corps officer who has himself previously been instructed.

7976. Is the Medical officer who is detailed to instruct the Staff Corps officer an expert in disinfection?—Not necessarily. This actual disinfection of houses on a large scale is, of course, new work practically to medical officers.

7977. You have quoted in one of your lectures the following statement about mahamari, and you refer to a report upon it: "No more cases occurred till a fortnight later, when the miserable people were driven back to the village by a heavy snowstorm, when 4 additional deaths took place within 5 days"?—Yes, Dr. Planck's* report. That is in the Kumaun Hills. I think I could probably get it for you. I will try to get the original report.

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* Printed in the Annual Report of the Sanitary Commissioner of the North-Western Provinces for 1876 (Allahabad, N.-W. P. and Oudh Government Press, 1877.)

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7978. Do you think that the most important thing to be done in India is to clean the houses, to make windows and to provide ventilation as a precaution against plague? I ask because I understand the general tenor of your evidence is to the effect that wherever you have filth there you have plague?—You have the soil prepared for it if you have the seed introduced.

7979. Do you see any difference between the case of plague and the case of small-pox?—It is practically the same thing.

7980. The steps you take against small-pox are to vaccinate?—Yes.

7981. You do not clean up the houses?—No, but still I think there is no question that you are much more likely to contract small-pox if you live in a stuffy, dirty, insanitary house than under opposite conditions.

7982. I understand you direct your efforts, in the case of small-pox, to vaccination?—Yes, because you can deal with it, and if inoculation for plague could be carried out to a sufficient extent I should think it would be very useful, but I do not think it is physically possible to carry out inoculation to the same extent as vaccination.

7983. I do not see that the one operation takes any longer time than the other?—You can be vaccinating all the time mostly; all the people are vaccinated. Plague comes upon a practically unprotected population: small-pox comes to a population the great majority of whom are already protected. Therefore your operations in the one case will be on a very much smaller scale than in the other. I am not prepared to say even if you could inoculate every one against plague, which, I think, is impossible, that it would enable you to dispense with sanitary measures. I think sanitary measures must always occupy the first place. If you make the place clean, I do not think the plague germ will live.

7984. Calcutta, I understand, is very dirty?—Yes, and it is most surprising to me that the disease has not spread more than it has.

7985. Do not you think that that points to the fact that plague is not a germ which is favoured by dirty surroundings?—I think from the whole history of the plague it is always very slow in taking hold of a place.

7986. You expect then that the plague will spread in Caclutta?—I do not say I expect it; I sincerely hope it may not, but I should not be surprised if it did.

7987. (*The President.*)—That it has not got much hold may be due to the mere accident that the cases which have already occurred have been seen and disposed of?—That may be so; they seem to have got early intimation of most of the cases.

7988. I understand you stated that you do not think inoculation is a sufficient measure to deal with the plague epidemic?—Not by itself. In the first place because, I think, it is impossible to inoculate a whole population, and in the second place because we know it is not an absolute protection. Even if it preserved 99 per cent. you have still 10 people in every thousand who are not protected, and who may contract the disease and spread it about.

7989. You cannot stop the epidemic even by having a sufficient amount of inoculation done?—I do not think so, and I do not think the people would submit to it.

7990. After an epidemic has occurred inoculation cannot proceed sufficiently rapidly to prevent further extension?—I think not.

7991. Do you think disinfection is valuable?—I think it is extremely valuable; the difficulty is to get it perfectly efficient. I am told that if you get the plague microbes injected into a solution of perchloride of mercury, 1 in 1,000, it kills them at once; but if you happened to leave a square inch of a house not touched by this perchloride of mercury solution, you may have a number of microbes left there, and the house is nominally disinfected, but it is not really disinfected.

7992. You cannot very well apply disinfection unless you empty the house?—It is extremely difficult to do so. Of course you must empty each room as you go along, and it is infinitely better to empty the house.

7993. If you empty each room you must place the persons somewhere where they cannot become sources of infection?—Yes.

7994. And that comes to be a form of segregation?—Yes.

7995. You have already pointed out that there are many objections to segregation in certain places?—Yes.

7996. It is impossible in large cities I suppose?—It seems so. They made enormous preparations in Bombay, but they were never able to carry out segregation measures thoroughly. If not carried out thoroughly it fails, and if you attempt to carry it out thoroughly, it leads to concealment.

7997. If carried out thoroughly you think it is good?—As a matter of theory it is absolutely sound, and in a small place and where it can be done, it has the effect of at once controlling the disease and stamping it out. We had an instance of that the other day.

7998. Each of these measures is very limited in its application—inoculation, segregation and disinfection?—Yes, I think so.

7999. And therefore I understand you to say there is a necessity for a marked improvement in sanitary conditions?—That I look upon as the essential thing.

8000. And in order to effect this marked improvement do you think there is a need in the first place for larger funds being placed at your disposal?—Larger funds are necessary. The money difficulty is one of the greatest, and always has been.

8001. Besides that, what is your opinion as to the human machinery for dealing with the sanitary condition of the country at present? As far as I understand, the chief officers have districts of enormous size, and the other officers for the most part are very well qualified men?—That is quite so.

8002. Owing to what has been effected, not only in India but all over the world, by improved sanitation, with regard to epidemic diseases generally, do you not think it would be important if there were in India a sufficient number of Health Officers with good qualifications whose time was entirely devoted to sanitary measures?—I do; I recommended it in my Presidential Address at the Medical Congress in December 1894. I said I hoped, as a counsel of perfection, that the time would come when each district would have such a sanitary officer.

8003. Is that financially an impossible reform?—It would be a very expensive thing, and extremely difficult.

8004. Have you considered generally what taxation per head of the population would be required to pay for an effective body of Health Officers for the country?—I have calculated somewhere in my lecture that an anna per head of the population would put Rs. 14,000,000 at the disposal of the authorities, but the trouble is to get your anna a head. It is not for me to say whether it is possible or not.

8005. You regard sanitation as the primary requirement?—I think a very large number of important works can be done; a great deal has been spent already. In this same lecture I gave a calculation which shows that if India were to spend as much on sanitation as England is supposed to do in proportion to population, we should spend £53,000,000, and the actual revenue of the whole country is only £36,000,000. This is an illustration of the frightful difficulty we have in front of us.

8006. You might at any rate have a fairly adequate staff of Health Officers by a taxation per head of one anna?—Yes, that is an academic calculation, but I cannot speak as to the possibility of realising it in practice.

8007. With regard to the duties of the Medical officers, yo think they are quite competent in many cases at once t enter upon important sanitary work, including bacteriology?—Yes.

8008. But as a matter of expediency they are usuall required to do two years with a regiment?—Yes.

8009. That would be very likely to make them forge much of their knowledge?—No doubt it does make the rusty.

8010. You say in certain exceptional cases these men might be entirely employed in scientific work?—Yes.

8011. In that case, to what extent would their prospects of the highest promotion in the service in India be affected?—They would have to take up a special line and stick to it. That is, they would be cut out from the highest rank in the profession, and would also be cut out from the administrative grade, and they would therefore forfeit an extra pension of £250 a year. You would have to decree that these particular officers were not to be a part of the Army Reserve, that they were to be essentially Civilians, and in that case you would have to pay them considerably more than you do at present, because you would deprive them of the increased pension and the increased rank which goes with length of service—from the highest rank at least.

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8012. (*Dr. Ruffer.*)—With regard to ascertaining the cause of death in India, do you think it would be possible to ascertain it in towns?—It depends on the town. I fancy we get much nearer approximation of the actual causes of death in towns like Calcutta, than in the rural districts—in fact, I am sure we do, and also in some of the big towns I dare say we get a fair amount, because there are a considerable number of private practitioners. A great many of the Hospital Assistant class do not enter the Government service, but go into private practice; they are competent more or less,—much less incompetent than the village authorities to say what a man died of.

8013. So that a proper system for ascertaining the causes of death by medical men could be easily applied in towns?—Much easier than in the country.

8014. Do you think it would be possible to get a system of death certificates?—I think you might, but I do not think it would be popular.

8015. In the case of a cholera epidemic do you disinfect the houses?—Not as a rule.

8016. Do you disinfect the linen?—No; nothing is done except to supply medicine as a rule. Each Civil Surgeon gets a store of cholera medicines to issue. When a village reports cholera, a quantity of those medicines is sent out, and a Hospital Assistant is occasionally told off to go there if it is a bad epidemic.

8017. You said something about having seen disinfectants used which you did not think were efficient; could you give us a specific instance of that?—I could, but I would rather not.

8018. You need not give us any names?—There was one disinfectant in particular as to which the proprietors write to me a letter about once a fortnight asking why I do not give them larger orders. As a matter of fact, I have been told by two officers who ought to know—one of them was Bacteriologist at Mysore, and another was an officer at Professor Haffkine's laboratory—that this disinfectant which professes to kill everything with one per cent. solution is practically useless under four or five per cent.

8019. Did you see that actually used?—Yes, I saw it used as a disinfectant.

8020. Who recommended that disinfectant?—I do not know; it has been extensively advertised.

8021. Do you know the case in which it was used?—I think it was being used at Karachi. I do not know whether it would be used officially or not; I do not think it had been supplied officially.

8022. Is there a disinfecting staff in towns at a time when there is no epidemic?—No.

8023. When an epidemic breaks out, who teaches the disinfecting staff?—As a matter of fact, I do not know we have ever organised a disinfecting staff until we had got to deal with plague.

8024. Who taught the disinfecting staff?—In Calcutta the Health Officer.

8025. And in the country villages?—I suppose it would be one of the multifarious duties of the Civil Surgeon, or of the Special Plague Officer.

8026. You have not in India a school or place where you can teach disinfection?—The elements of hygiene are taught in the Medical Vernacular Schools. Among other things they are taught theoretically about disinfection, and there is no doubt that they see special wards disinfected, after cases of septicæmia or something of that sort.

8027. When a Staff Corps officer is in charge of the plague operations in a district, has he not the Civil Surgeon practically under his orders?—I do not think the Staff Corps officer has the Civil Surgeon under his orders.

8028. But the Staff Corps officer is not bound to follow the Civil Surgeon's advice?—No, but I should think he probably does. Technically I presume he is not bound to do so.

8029. Supposing the Civil Surgeon says "I am going to paint this wall white", and the Plague Officer in charge says "I am going to paint it black", who decides?—It depends on their relative position. If the plague operations are put under a Special Plague Officer, the Civil Surgeon would have nothing to do with it.

8030. But who advises him?—In that case the Special Plague Officer would decide.

8031. Suppose the Civil Surgeon sees that the Plague Officer is doing something which, in his opinion, is harmful, to whom can he go; suppose, for instance, to take an extreme case, he saw him scattering bacilli about the room?—He could only represent the matter to the Inspector-General of Civil Hospitals, but he has no power to stop him.

8032. The Sanitary Boards have been in existence since 1888, have they not?—Yes.

8033. Could you suggest any papers where one could find what those Boards have actually done?—I can get up a note of that kind for you, and I shall be very happy to do so.

8034. Have they done much as a matter of fact?—Some of them have done very little, and some a great deal in a quiet way. As I mentioned just now, on looking over the proceedings of one of these bodies some time ago I found that they had met twice, but had done a great deal of work by circulating papers.

8035. The Sanitary Boards have some power with the Municipality, have they not?—I do not think they have any power of compulsion.

8036. They could not compel the Municipality to engage more Medical Officers of Health?—No.

8037. In a town like Bombay, for instance, there is at present one Medical Officer of Health for the whole town; who could appoint more Medical Officers of health?—It is a question of law. But I should think if the Local Government considered there ought to be additional Medical Officers of Health, they would bring the matter before the Municipality, and if they put pressure on them, I think the Municipality would probably agree to it.

8038. There is nothing to compel the Municipality to do so?—I think they could compel the Municipality practically if they wanted to. But it would require some very, very cogent reasons to make the Government compel the Municipality to do something which it strongly objected to do.

8039. It is never done, I suppose?—I am not sufficiently up in Municipal history to know, but I doubt if it has been done.

8040. You yourself could not do it?—I have no power at all, I can only give advice.

8041. With regard to these villages in the Hills in which mahamari cases occurred, they are very long away off, are not they?—Yes.

8042. Can you tell me how near the first village is?—I have never been in Kumaun. These villages are not shown in any map, but I understand they are deep in the Hills, and that the people move about very little. They stick very close to their villages.

8043. You have said you think the best measure to take would be the general sanitation of the whole country?—Yes.

8044. That is a matter of time?—Of a very long time, I am afraid.

8045. At the present moment what paactical measures would you advise?—Practically I should do all that persuasion can do to evacuate, segregate, and inoculate, and to clean out. There is no question as to the rightness from a sanitary point of the view of all the regulations, the only question is how far you can practically enforce them. I should enforce them as far as possible by persuasion, and I think you can do a great deal in that way.

8046. (*Mr. Hewett.*)—With regard to the position of the Staff Corps officers when working in the district under the Civil Surgeon, is it not the case that both the Plague Officer and the Civil Surgeon are under the Collector for the purposes of plague management?—Yes.

8047. Therefore, if there is a dispute, it would be decided by the Collector?—Yes, no doubt it would.

8048. You said just now that a possible explanation of the fact that the epidemic in Calcutta was not violent was that the executive got hold of a large number of people very quickly; have you noticed any great discrepancy between the number of male and female attacks in Calcutta?—I do not know that I have particularly, but I would point out that the population of Calcutta is two males to one female; that is the normal population.

8049. May I draw your attention to the proportion of females. I cannot put my finger on the statistics after Dr. Neild Cook was relieved of the duty, but to the end of July there were 190 plague attacks of which 152 were male attacks?—That is more than the normal.

8050. That is 152 males and 38 females, a proportion of 4

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to 1. Does not that rather indicate that there was some concealment?—I do not think there can be much concealment, because they probably got the total number of deaths registered. Though occasionally deaths may have been attributed to other diseases, I think they must have got the total deaths. I think it would be very difficult to dispose of a body in Calcutta.

8051. We have had evidence that in one instance a case of plague was returned as chronic rheumatism?—Yes, I think it is possible.

8052. And that was only found out because the Medical Officer who saw the case told the Health Officer that it was a case of plague?—Yes, I do not think there can be much concealment in Calcutta because the total number of deaths is decidedly less than the average.

8053. That is one of the facts which we are trying to account for?—I do not know why there should have been so many more men than women; the normal population is 1 to 2, not 1 to 4.

8054. Do you think the registration of deaths in small towns is at present fairly efficient?—The actual number of deaths is probably approximately correct, but the causes of death are extremely incorrect. I think it must be so, because the great majority of people are not seen by scientific men at all, and they put down everything either to fever, or bowel complaint, or cholera—they have three or four names.

8055. (*Mr. Cumine.*)—To supervise the disinfection of a house properly I suppose the supervising authority should always be present and see the work going on?—Unless he does, he has no guarantee that it is done thoroughly.

8056. If he turns his back to supervise the disinfection of another house, during his ten minutes' absence some nook or cranny may be omitted?—Yes.

8057. So that in a district where there are fifty villages infected to thoroughly supervise the disinfection of every house you would—if you insisted on having medical men—require a hopelessly unattainable number?—Yes.

8058. Did they not in Bombay train what they call Flying Columns?—Yes, generally I think under the charge of a Staff Corps officer. I spent an hour or two watching the proceedings of a gang that was under two Staff Corps officers, and they were doing it extremely well.

8059. They trained these gangs, and so they were ready for despatch to any place in the mufassil where plague broke out?—Yes.

8060. Besides that, I think they got down a certain number of clerks from the different districts and tried to teach them disinfection?—I was not aware of that; I thought they had a clerk to keep records of the houses and deaths, and so on.

8061. I think cholera sweeps right through India every year?—No, it has been much better of late years; it varies from year to year, but we have not had, in recent years, anything like the bad epidemics we used to have.

8062. When a village is infected by cholera all that is generally done is to send some bottles of medicine?—Yes occasionally if it is very bad we send a Hospital Assistant or two perhaps.

8063. You said the Civil Surgeon had no executive authority within the limits of the Sadr Station town?—He can only give advice.

8064. Would he have any executive authority in cholera-attacked villages, and be responsible for them?—He has not legally got any; but he can do a great deal if he is a man of tact.

8065. Does he find time to go out there?—Yes, generally. If there is a bad cholera epidemic, he generally finds time to go out, and if he is a man who is known and respected in his district, and is a man of influence, he can get a great deal done; but he has no legal power of ordering it to be done, that I know of.

8066. Is it not specially *within the houses* of the people that the greater light and ventilation and cleanliness necessary to prevent the plague germ flourishing are required?—Yes, mostly in the houses. The houses are generally damp; they have an absorbent mud floor and very little light, and no ventilation, as a rule, except what they get through the tiles of the roofs.

8067. If you were to prescribe a certain amount of light and air and cleanliness in the house you would require an establishment to go about to see that your orders were carried out?—You would require to re-build the whole of India.

8068. A European establishment sufficiently large to see that such orders are carried out is unobtainable?—I should say so, except at an absolutely prohibitive cost.

8069. The native establishment is in its inferior grades apt to be corrupt and inefficient?—It is likely to be, but it is more that they do not understand it. They think these things are fads, and they do not carry them out more than they are obliged.

8070. At any rate the re-building of India is not a practicable measure?—I do not think so.

8071. (*The President.*)—Do you mean that in order to get light you would have to re-build India?—If you re-built on the lines of a Building Act and compelled a certain amount of light and cubic space and ventilation for each house you might do it, but if you left it to the natives themselves you would not get it. You can instruct them, but we found in England that when there was a window-tax, windows were made small, in spite of our enlightenment.

8072. That was before the days of enlightenment?—Well, before a good deal of enlightenment.

(Witness withdrew.)

LIEUT.-COL. FULLERTON, I.M.S., called and examined.

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8073. (*Mr. Cumine.*)—You are Agency Surgeon in Baluchistan?—Yes.

8074. You are prepared to describe the measures which have been adopted in Baluchistan with a view to prevent the spread of plague into Kalat and British Baluchistan, and by way of Baluchistan into Persia and Afghanistan?—Yes. The question has from the first received the fullest and most careful attention from the Baluchistan Government and the measures adopted have been most thorough and efficient.

8075. What are the three chief routes by which plague might enter Baluchistan?—The three chief routes by which plague might enter Baluchistan direct from infected areas in India are the sea, the Karachi-Sonmiani Kafila road, and the Baluchistan branch of the railway from Sind.

8076. I suppose, so far as the sea route goes, there are certain definite ports at which people have to land? Can you tell us the places which had to be guarded?—Sonmiani, Ormara and Pasni.

8077. You knew where the people who came by sea would land?—Those are the chief ports.

8078. What measures were taken when it was found that plague had broken out in Karachi?—A strict watch was kept on the passenger traffic between the Indian and Baluchistan coasts, and passengers and crews were subjected to inspection and observation before being allowed to land on the Las Beyla or Baluchistan coasts. Las-Beyla comes in between the Karachi coast and the Baluchistan coast proper.

8079. So much for the sea route. Then we come to the Karachi-Sonmiani Kafila road; does that pass through a desert for many miles?—Yes.

8080. So that anybody who comes from that direction would come by this road?—The chief land traffic in southern Baluchistan uses that road.

8081. At first you had a number of medical subordinates I think, on this road?—On this road there was one subordinate. One subordinate was appointed as Inspecting Medical Officer, and he had authority to examine and inspect all travellers coming from the direction of India, that is coming from Karachi practically, because the road begins at Karachi. He had power to retain persons suffering from suspicious symptoms and to place them under observation and treatment.

8082. Was there general detention of everybody, whether suffering from fever or not?—No.

8083. At the ports was there any general detention of everybody landing?—As a rule, they were detained for some time until the officer in charge was satisfied that they were free from the disease. It would be the same, of course, in the case of the Sonmiani-Karachi traffic. If the Medical Officer had reasonable grounds to suspect that any person might be suffering from the disease, he had authority to detain him.

8084. Was everybody detained?—Not further than for the purpose of disinfection and inspection.

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8085. Then we come to the third route, namely, the railway?—On the railway line at first I think all passengers entering Baluchistan from Sind were subjected to medical inspection only, repeated at frequent intervals, commencing at Sibi. All passengers exhibiting suspicious symptoms were removed to segregation huts for treatment and observation.

8086. The railway line between Jacobabad and Sibi, like the Karachi-Sonmiani road, passes through many miles of desert?—Yes, about 100 miles of almost waterless desert country. At all the stations in this section all booking of passengers was forbidden, and passengers were forbidden to leave the train. All passengers leaving Jacobabad were carried on to Sibi to be medically dealt with there.

8087. That was the first arrangement?—Yes.

8088. When plague began to spread, and other localities than Karachi began to be infected, I think you started a segregation camp?—Yes; it was decided that a segregation camp should be started at Sibi, where all or nearly all native and other passengers should be treated as plague suspects and subjected to detention.

8089. For how long were they detained?—The period was limited to ten days for observation and disinfection.

8090. When were those measures commenced?—They were commenced towards the end of March 1897, and have since then been in operation so long as there has been plague in Sind.

8091. That is to say, they are in operation now?—Yes, there is a segregation camp at Sibi at present, under the superintendence of a Commissioned Medical Officer.

8092. How many cases of plague were discovered among the railway passengers?—Three, one of which was taken out of the train by the Inspecting Officer at Sharigh, one developed plague in the segregation camp at Sibi, and one who was found in the train and sent back to Jacobabad. The first two cases proved fatal.

8093. How many cases were found out of those landing at the different ports?—There were not any.

8094. How many cases on the road?—No cases were found.

8095. I think a special Plague Committee was formed at Quetta?—Yes, with the General Officer Commanding the District as President. Last summer I was appointed President and still hold office.

8096. Has Quetta been thoroughly cleaned?—Yes; the houses found unfit for human habitation have been pulled down, and segregation camps and hospitals have been appointed. All the more important district out-stations have been similarly dealt with, and the sanitary condition of all is still carefully attended to.

8097. Have the ordinary villages been dealt with?—No, and inoculation has not been introduced.

8098. So far, I think, you have not had any cases of plague in Baluchistan with the exception of the three imported cases which you have referred to?—That is so.

8099. Have you anything you would like to add to the above?—No, except that it is considered very advisable to take very careful precautions against the admission of plague into Baluchistan. The chief roads are so few that competent supervision can be exercised in a way which is not possible in other districts. There are only three chief routes, and the country is very sparsely populated, and if you watch these routes very carefully, the chances are you get hold of the chief traffic and place the travellers under efficient medical supervision. In that way you get to know what is going on. So far there has not been any plague in Baluchistan, and I believe that this result has been due to the measures which have been taken, and are being persistently taken.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Home Office, Calcutta.

TWENTY-THIRD DAY.

Wednesday, 4th January 1899.

PRESENT:

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

MR. G. R. FERRIS called and examined.

Mr. G. R. Ferris.

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8100. (*The President.*)—What is your medical qualification?—I am Member of the Royal College of Surgeons, England.

8101. I believe you are practising here?—Yes.

8102. How long have you been in practice here?—Since 1853, without intermission.

8103. Then you must be familiar with all the diseases of Calcutta?—I am.

8104. Have you seen any cases of plague in Calcutta?—I have seen no case of plague.

8105. Have you seen any cases which are similar to cases of plague in your opinion?—I have not; they have not come before me in my practice, so that I could have no idea at all that they had the characteristics of plague.

8106. Have you seen any cases which in any respects resembled cases of plague?—None. I have seen cases of fever in which there has been a very high temperature and the lymphatic glands had been affected.

8107. What glands?—The axillary glands, for instance, and the inguinal glands. I have seen those affected. I recollect more particularly that I noted at that time, in 1858, when we had an epidemic of cholera here, we had a type of very destructive fever also. I have no doubt the medical annals will carry you back to the case. We had a type of fever which was very rapid and very destructive.

8108. Do you mean fatal?—There were a great number of fatal cases. The percentage of deaths from that fever was larger than in any year, I recollect. In those cases where the fever rose rapidly, and went up to 106, enlarged glands followed. The glands seldom suppurated however. Few persons survived. They did not go on to the inflammatory stage; they were indurated. In the first place, they might be slightly inflammatory, but they never suppurated.

8109. How long did the fever generally last?—It was very rapid. I recollect a number of cases in which the time from which the patient considered himself in health up to his demise was up to 48 hours.

8110. When the patient recovered, how long did the fever last; did the fever last in cases of recovery?—From the commencement perhaps, to the termination: the utmost would be seven days.

Mr. G. R. Ferris.

4th Jan, 1899.

8111. You could not refer them to any known fever?—No, it was a very unhealthy year. I think there was a more malarious type of atmosphere during 1858 than we have since had.

8112. Have you recently seen any cases of fever with enlarged glands in Calcutta?—Yes, I have seen them lately.

8113. Between 1858 and the present time?—We have frequently had a large number of cases.

8114. In nearly each year between these years?—A year has not passed since 1858 when I have not seen glandular enlargements with fever.

8115. Have they been frequently met with lately, or not?—I do not think so.

8116. What is the nature of the cases you now see; could you give me some description of them?—They are only cases of continued fever. The temperature rises very rapidly, and the glands are affected a little more speedily than in ordinary cases. These are not cases which are fatal. There have been very few fatal cases of fever; in fact I am unable to mention any. They have all recovered.

8117. How long has the illness lasted at the present time?—From the commencement of the fever to convalescence, I should say three days.

8118. Has there been any eruption?—No; I should say nothing of the typhoidal character. I will not say typhoidal; perhaps some of them have had a low typhoidal character, but it has not been typhoid.

8119. Have the glands ever suppurated?—No. Of course you will get fever in the case of a man who has an ordinary bubo. He may have that before he has any fever at all, in cases of syphilis and so on, but that is a different thing.

8120. I am referring only to the cases you have spoken of, not cases of syphilis or of venereal disease—only this other type you are speaking of?—In those cases I have no recollection of their going on to suppuration.

8121. Have you any idea whether they are infectious, or contagious, to any extent?—I should say they are non-contagious and non-infectious.

8122. In your experience are these cases totally different from cases of plague?—From the history I have had of plague I think they are different.

8123. Have you ever seen a case of plague?—No.

8124. (*Mr. Hewett.*)—Have you seen any case which other doctors considered to be plague?—I have not seen a case. I have had histories of cases from other medical men in Calcutta, but I have not seen a case of plague.

8125. You have not seen any of these cases which the other doctors have called plague?—No.

8126. How would you account for the death of these 192 persons out of 230: it is a large proportion What do you think these people have died of?—Doubtless from plague. There are a number of cases which I have seen which I think have been mistaken for plague. The natives of India have not got a great amount of stamina, and their nervous system is easily excited. In many cases I have seen, I believe, that had you attempted to remove them, they would have got frightened. They would think you were going to take them to the Plague Hospital, and I believe that some of the men that would have recovered, if left quietly alone, would die.

8127. Do I understand you to say that you are of opinion that these 230 cases were plague?—From the history I have no doubt that they were. We are speaking of course of the general rule—the majority.

(Witness withdrew.)

Dr. JAMES R. WALLACE called and examined.

Dr. James R. Wallace.

4th Jan, 1899.

8128. (*The President.*)—Are you in practice in Calcutta?—Yes, I practise here.

8129. Have you any official post?—No, I have no official position, but I am editor of the *Indian Medical Record,* a weekly journal.

8130. You are in general practice?—Yes, I am in general practice.

8131. What are your medical qualifications?—I am a Licenciate of the Royal College of Physicians and Surgeons, Edinburgh; I am a Fellow of the Royal College of Surgeons, Ireland; I am a Licenciate of the Society of Apothecaries, London, and a Doctor of Medicine of the University of Brussels.

8132. How many years have you been in practice here?—I have been in practice in Calcutta for 17 years.

8133. (*Prof. Wright.*)—Have you seen any cases of plague?—I have seen cases that have been diagnosed by others as cases of plague.

8134. Where did you see real cases?—I have not seen any *real* cases, but I saw five cases diagnosed as plague in the Municipal Hospital in Manicktolla. From the reports published about them I noticed that these cases were all diagnosed as plague.

8135. Did you go through the hospital with a medical officer in charge, or did you go alone?—I went with a medical officer.

8136. Did he point out these five cases as cases which had been diagnosed as plague?—Yes.

8137. Was the hospital devoted only to plague, or to general disease?—It was the Plague Hospital in Manicktolla.

8138. Were you of opinion that none of those cases were plague?—I was of that opinion.

8139. Were there any buboes?—One was a case of inguinal buboes, and one was a case of axillary buboes.

8140. What about the other three cases?—One was that of a woman with a swollen breast nursing her child.

8141. Was there no bubo?—There was no bubo, but there was a painful axilla. The other was a case of a man who had a wound in his hand; he had a great amount of general œdema of the wounded arm. It was stated that he had got infected in assisting at the *post-mortem* examination of a man said to have died of plague.

8142. What about the fifth case?—The fifth case was that of a little boy who was in hospital with his sick mother. I was told that he was the son of the woman who was suffering with an abscess of the breast. She had also a baby with her.

8143. What was the matter with this little boy?—This little boy had an open sore, an ulcer, on his knee.

1844. Had he any buboes?—He had no buboes, but had fever.

8145. What about the other two cases that had definite buboes?—One was a khalasi, a boatman, from one of the River Steam Company's steamers. He got his leg injured, and he had a swelling in his groin, which was very tender, and he had high fever.

8146. One was an axillary case?—One was an axillary case suffering from fever, and there was painful swelling about the axilla. The glands were not swollen.

8147. These two cases which you saw, this inguinal case of the man who had hurt his foot and the other one, why did you think they were not cases of plague?—The reason was simply this, that there were no urgent symptoms, such as characterise plague, and the fever was of an ordinary character, just purely traumatic. Practically, the main symptoms of plague were not there.

8148. Do you mean that the fever was not severe enough to make you think that it was plague?—Not so much that, as the absence of extreme nervous depression, and dullness of the intellect. In the inguinal case there was the history of an injured foot clearly pointing to an exciting cause for the glandular swelling: in the other case there was the injury to the hand.

8149. Do you think that the injury to the foot would offer a good chance to the infection of plague, if plague was about?—Quite so.

8150. You would not exclude that as a possible cause?—No.

8151. You suppose these were not plague because there were no serious nervous symptoms?—At the time I saw them.

8152. Did you speak to the men?—Yes, they spoke perfectly intelligently, except the man who had been infected by the dissection wound.

8153. Who was the medical officer who was responsible for the diagnosis of plague in those five cases?—I do not know who was responsible for the diagnosis. The man in the hospital, an assistant surgeon, I forget his name, told me that they had already been diagnosed as cases of plague. I said nothing to him. In my report to the Chairman of the

Municipality I said I was distinctly of opinion that none of those cases were cases of plague.

8154. You did not discuss the diagnosis with the medical officer responsible?—No.

8155. Are you quite sure that these cases were actually diagnosed by the medical officer as plague?—I can only go by the statement of the medical officer, and by the other official statements, which I think are a sufficient guarantee that they were so diagnosed. Mr. Greer, the Chairman of the Corporation, and Mr. Hughes, the Chief Engineer of the Corporation, called on me the next morning and told me that these cases had been diagnosed as cases of plague.

8156. If you had suspicious cases of that sort, cases of buboes, would you not provisionally regard them as plague supposing there was an epidemic of plague in the town?—I am rather chary about things of that sort. I should not be inclined to call it a case of plague, if it was not one. Supposing there was an epidemic abroad, I might segregate those cases for the purpose of safety, but beyond that I do not think I should be inclined to give myself away so easily with regard to the diagnosis.

8157. You took no steps to meet the doctor in charge, and discuss the matter with him; might he not have given you other facts?—He was a subordinate officer. I was sent by the Municipality to examine these cases and report upon them, and I did not think I was called upon professionally to make any statement to a subordinate officer in the place.

8158. Have you seen any of the other cases diagnosed as plague?—I saw a case in the Chandni Hospital, diagnosed as a case of plague, and reported in the *Indian Medical Record* of the 16th June 1898.

8159. Who was responsible for the diagnosis in that case?—Dr. Panioty, the Resident Surgeon. I told him I did not think it was plague.

8160. Is Dr. Panioty in Government employ?—He is in Municipal employ.

8161. Can you tell us something about this case which you say was diagnosed as plague; what were the symptoms?—This man was suffering from high fever, and had a very tender glandular swelling of the groin, and a slight attack of gonorrhœa. I referred the glandular swelling to gonorrhœa, and the high fever to malarial infection. I told Dr. Panioty at the time that I did not think that it was a case of plague at all. It was so reported. The man recovered.

8162. Have you seen any other cases but these?—I saw another case in one of the lanes in Calcutta. I was called in to that case. It was reported as a case of plague, and the plague officers were making an investigation about it.

8163. Who called you in in that case?—The father of the child, Captain Wright. I saw this child, who was about three years old. The child had fallen from the bed, and had injured its leg. There was a large painful swelling in the femoral region; and the chain of lymphatics was badly swollen. There was high fever, and considerable nervous irritability and depression.

8164. Who had diagnosed it as a case of plague?—One of the plague officers. I do not know who. I met a plague officer a few minutes after seeing the child, and I mentioned it to him and told him that the case was pronounced as being suspicious, that I had just seen it, and that I thought it was a case which might be watched and isolated.

8165. You thought it might be plague?—I thought it was a case that might be suspicious, notwithstanding there was the history of the fall, owing to the general surroundings. It was a filthy house, in the midst of decomposing organic matter. One would almost expect a case of plague there at any time.

8166. What happened in this case?—It recovered.

8167. Are you now of opinion that that was a case of plague?—I think it was not a case of plague. Dr. Sanders saw the case. The next day the symptoms subsided considerably. At that particular time, and in that particular neighbourhood, there was considerable excitement about the existence of plague. Everybody was keen on finding it in that particular locality. I think it is called Kapalitola Lane.

8168. Has this case been recorded as a case of plague, or was the diagnosis altered?—I am not quite sure whether that is so. I have here a record of the cases of plague so diagnosed.

8169. Do you know what Dr. Sanders' report on this case was?—He said he thought it was not a case of plague.

8170. You agree with Dr. Sanders?—Yes.

8171. We have had six cases in which there was a disagreement of the diagnosis; this one you are in agreement with?—Yes. As not being a case of plague.

8172. In the other cases you are in disagreement with the diagnosis?—Yes.

8173. There are six cases, five in the hospital and Dr. Panioty's case?—Yes.

8174. And in the seventh case you are in agreement with the diagnosis that it was not plague?—Yes.

8175. In the other case which is diagnosed as plague, you saw no reason to differ with it?—No, my opinion was that it was *not* plague. I made a second visit to the Manicktollah Hospital, at the request of the Municipality, and saw those cases again a few days later. I was still more confirmed in my opinion that they were not cases of plague.

8176. I understand you have stated that you think there is no plague in Calcutta?—Yes.

8177. You base that on the fact that you have seen six cases diagnosed as plague, which in your opinion were not cases of plague?—Yes.

8178. Have you taken any further steps to verify this opinion of yours; there have been 190 deaths I understand from plague: have you sought out any of these cases?—No; I have seen none of the other cases that were diagnosed as cases of plague. Perhaps I might qualify that and say that I went down to the Medical College Hospital and asked Dr. Bomford if he would let me see some cases of plague. I had been telegraphed to from Bombay by a Captain of one of the vessels to see his child. I was not able to see the child, but I saw the child of a man named Cross who telegraphed to me from Bombay to see his child in the Medical College Hospital. I went to Dr. Bomford and asked if he would let me see this child. He said, "Yes, I will be very glad to show you all our cases". He came down and showed me all the cases they had in the Hospital. I saw this particular child suffering from high fever. Dr. Bomford said the child was doing well; he did not take that to be a case of plague. That was Dr. Bomford's own opinion. I expressed no opinion about it. I know that Dr. Bomford said that that was not a case of plague, and that the child was doing very well.

8179. You have spoken of these five cases in the first hospital, another case in Dr. Panioty's hospital, and another case here; none of these eight cases died, did they?—I do not know. I called a couple of days later to see the cases at Manicktollah Hospital and they were alive and were apparently better. I believe the man who suffered from infection from the dissection wound died, but I am not quite sure.

8180. In view of the large mortality occurring among the other cases do you not think it is reasonable to suppose that plague has been in Calcutta, or do you think that the fact that you have seen these cases precludes that?—I am strongly of opinion that these cases were cases of malignant fever of a malarial type, or a septic type, in which glandular infection has been the characteristic feature. They have run the ordinary course. I am talking of the cases generally in Calcutta because there has been a great effort to ferret out these cases, and I believe that if that policy of ferreting out cases continued, cases of that particular description might be found in Calcutta for the next half century, unless Calcutta is revolutionised in the matter of sanitation.

8181. Have you had under your charge any of these cases?—No, I had one case which I wish to call special attention to. I have a note of it here. It is the case of a man named Smith. It is the 9th case. This man was under my treatment as a case of malarial fever from the 24th to the 27th April 1898. The temperature had run high. It was not one of those cases of malignant fever, but a case of rather severe malarial poisoning. He was under my treatment for five or six days, and up to that time he had not developed a single sign of plague—not a single bubonic swelling anywhere, nor any pneumonic symptoms. He was doing fairly well, until one night when owing to a great disturbance on the tram-lines, which were being repaired and which caused a great deal of noise, his symptoms got worse. The fever rose and he got light-headed and became delirious. They sent for me. I was out on an obstetric case, and did not come home till late. His friends came two or three times for me that night and as I was not in, they took him away to the General Hospital. The same day Smith was diagnosed as a case of plague. He was kept in the floor ward, which is known as the D. T. Ward, and he died. He was diagnosed as a case of plague, but I am perfectly confident that that man had no more plague than any other ordinary case of fever, *Dr. James R. Wallace.*

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He never developed a single bubonic symptom. I got a report of his case verbally, and I found that he developed no bubonic symptoms nor any pneumonic symptoms: he had an excessively high temperature affecting his brain.

8182. Was there a *post-mortem* held?—No, no *post-mortem* was held; I know that, though the hospital reported it as a case of death from plague. The Health Authorities came to disinfect his house and to destroy his bedding and other things. When they went in to the case they took none of these precautions. His bedding and clothes were not burnt and his house was not disinfected.

8183. Has that gone down in the records as a case of plague?—Yes.

8184. Do you know whether any bacteriological observations were made in this case?—I know there were not.

8185. All these facts you have told us go to show that a number of cases have been wrongly diagnosed as plague?—Yes.

8186. Have you not taken the trouble to find out whether all these cases have come under this category: have you not asked to be shewn actual cases of plague?—I have gone into the reports published by the Municipality, and by the Bengal Plague Commission, and it is only upon these reports that I have based my comments in my journal. These reports have not satisfied the public that sufficient bacteriological investigation was made and that the diagnoses, judged by the published reports of what has been done in connection with the diagnoses of these cases, are based upon bacteriological examinations.

8187. Have you seen plague elsewhere?—I have seen plague in Bombay in September 1897. On my way from England I stayed at Bombay a few days and went round the hospitals and saw cases of genuine plague.

8188. (*Mr. Hewett.*)—Can you tell me the name of the doctor who attended this man Smith in the hospital?—I do not know the name of the doctor who attended him. He went into the hospital and was attended by one of the staff.

8189. At the Medical College?—At the General Hospital.

8190. (*Prof. Wright.*)—Do you remember the case?—I do, but I have not the particulars with me.

8191. (*Mr. Hewett.*)—When did you see these five cases—in the early stages of the epidemic or later?—It was shortly before the plague declaration of Government; in fact it was upon these cases I think that the declaration of Government was based.

8192. Was it at the very early stage?—Yes.

8193. You did not see any of the seizures except those which you have mentioned from the time that plague was declared to exist in Calcutta, until the time that Calcutta was declared to be free from plague?—Yes. For instance, there was this particular case in Chandni Hospital, those in the College Hospital and the one in Kopalitola Lane.

8194. With the exception of those you mentioned?—No.

8195. There was a large majority you did not see?—Yes.

8196. I think you said that you thought this might very well be a peculiar type of fever, and that their number might be accounted for by the fact that cases had been ferreted out?—Yes.

8197. What proportion of deaths would you expect to find as between males and females?—Usually the percentage of deaths is larger in females. I base this upon experience gained when I was Resident Physician in the Medical College Hospital, and also during the time I was a student in the Calcutta Medical College.

8198. Do you mean that the deaths of females are larger?—Yes, larger.

8199. Despite the fact that there are more males in Calcutta than females?—Yes.

8200. At this particular time of course many females had left Calcutta, had they not?—Possibly.

8201. Do you know what is the proportion of these alleged cases of death from plague among males and females?—I have it here upon an official statement, made from the records of the Municipality, that there were 210 cases; 174 died, 29 recovered, and 7 were under treatment on the 13th of August when this report was made.

8202. I daresay you will accept my figures as I have worked them out. From the two reports of the two Health Officers, it appears that there were 197 male deaths, and 33 female deaths, making a total of 230; whereas you have only got 210 cases there. Do you think that that indicates all the cases were not found?—It is quite possible that the females were hidden away, secreted.

8203. (*Dr. Ruffer.*)—Do you accept the bacillus of Yersin to be a cause of plague?—I accept the general verdict of the medical profession. I believe that verdict is that the bacillus of Kitasato and Yersin is the cause of plague.

8204. Supposing you found it in a patient who had high fever and buboes, do you think it would be a valuable aid of diagnosis?—It would, but it is the verdict of the profession that the existence of this bacterium is the actual cause of plague.

8205. If you had a case of fever with buboes in Calcutta, and you found the plague-bacillus, would you have any doubt as to its being a case of plague?—If I was certain that men like Yersin or Kitasato had diagnosed the case by bacteriological examination, I should be inclined to think the evidence of such an expert was a sufficient guarantee for the presence of the bacterium, but hardly otherwise.

8206. Is it not the case that the bacillus of plague has been found in certain patients in Calcutta?—I question whether bacteriological experts in Calcutta are qualified to give an opinion as to the presence of this bacterium in the blood.

8207. Were specimens not sent to M. Haffkine for examination?—Samples were sent from here, and there is just the possibility of doubt of local infection, local change taking place in M. Haffkine's bacteriological laboratory. I do not accept that decision about the blood sent to Haffkine at all. I accept it with a considerable amount of salt.

8208. What do you mean by local changes?—I mean the serum in that particular case was sent to M. Haffkine. That serum was exposed to outside contamination in his laboratory. His laboratory is one in which bacteriological examination of plague cases, and of plague blood, had been going on for some time, and it is quite possible that a contamination of the serum sent from Calcutta might occur in M. Haffkine's laboratory. I think that the conditions under which that examination was made are not fair with regard to coming to a correct diagnosis.

8209. But have there not been cases since? Have not bacteriological examinations been made in these cases? Are you not satisfied with M. Haffkine's evidence?—Certainly not. I am not satisfied with M. Haffkine's opinion in the case of the blood sample that was sent to him. I wish to say with regard to the statement about malignant fever in Calcutta that I remember as well as possible, as a medical student in Calcutta, Dr. Chevers, Professor of Medicine and Principal of the Medical College, used frequently in the Observation Wards of the Medical College to draw the attention of students to cases coming in with what he called pernicious, or malignant fever, with symptoms very closely allied to the general symptoms of the disease that is now called plague, symptoms that I believe have been diagnosed as the fairly characteristic symptoms of plague in Calcutta. Dr. Chevers used to draw the attention of the students to these cases in this remarkable way: "This man has malignant fever: he will die in 48 hours". It was a well observed fact in connection with these cases that those that had not developed buboes died within 24 hours as he said, and that those who developed buboes and were in this peculiarly acute stages of fever, where there was a great deal of nervous prostration and brain symptoms, died within the 48 hours: that is, there was a much higher mortality in those cases of distinct pneumonic trouble, than those with simple bubonic trouble and high fever. I observed the same conditions when I was Resident Physician to the Medical College Hospital. Cases like that were brought in and they died. I am perfectly certain in my wanderings through Calcutta as a practitioner, that cases of malignant fever of a distinctly fatal type (in which 90 per cent. are fatal) have existed in this city for many many years, and that they are dependent entirely upon soil pollution, and are absolutely due to the grossest sanitary defects.

8210. (*Prof. Wright.*)—Supposing you had a case of this sort come under observation, have you any means of getting it bacteriologically tested, in order to determine whether or not it is right?—We have no bacteriological expert in Calcutta. We had one in Dr. Cunningham, a man who was trusted by the whole profession. Our very weakest point in Calcutta is that that we have no bacteriological expert. This has been the great weakness of the Government during its present trial, and it caused a serious crisis for the Government and for our city. There is no question about the fact that the whole plague scare hinged upon the absence of a careful expert bacteriological examination. These means were not at our disposal. I wish to say another thing, namely, that it is very important for

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Calcutta that the Government should recognise that, unless Calcutta is improved structurally, its bustees cleared, and these over-crowded areas opened up, there is no possible chance of getting malignant fever mortality lowered. These plague spots exist, and we will get that particular form of malignant fever as long as they do exist. Our duty is to lay that as clearly as possible bare before the Government.

8211. (*Dr. Ruffer.*)—Have you seen a *post-mortem* of any of these six cases?—No, I have not. The only one that I think died was the man who had undergone infection in the *post-mortem* room.

8212. They all recovered?—I do not know that. I do not know their subsequent history. I think that one man died, but I saw no *post-mortem* examination in that case.

8213. With regard to malignant fever, you saw buboes in your student days; were the glands shotty, or was there œdema?—There was a good deal of œdema.

8214. Having seen plague cases in Bombay, and these cases here in Calcutta, do you see any differences between them clinically?—There is very little difference between them clinically.

8215. (*The President.*)—Is there any difference?—Except this, that with the experience of years, I was able to look upon these cases and characterise what struck me as being almost diagnostic of plague, namely, the peculiar condition of the tongue. I saw it probably in 50 or 60 cases in Bombay, and Dr. McCabe Dallas, one of the experts in Bombay on plague matters, dwells upon it in the *Record* as being characteristic in the diagnosis of plague clinically, this state of the tongue.

8216. (*Prof. Wright.*)—You found that in those cases?—I found in the cases in Bombay, what I did not find, as far as I can recollect, even to the time I was Resident Physician in the College Hospital, that peculiar condition of the tongue in plague cases. The condition of the tongue in cases of malignant fever differs very much.

8217. I understand you to think that this malignant fever and plague are practically undistinguishable without bacteriological observation?—I should fancy that they are too closely allied to make much clinical difference between them.

8218. (*The President.*)—If you were informed that a large number of those 230 cases you referred to have been examined bacteriologically, would that alter your view that they were plague?—It would depend very much upon who made the bacteriological examination. I do lay very great stress upon this point, and it is on this point we have made an error.

8219. Assuming that the bacteriologist is a competent man and did find the bacillus, what would you be inclined to say?—I should be inclined to say that I would accept the bacteriological results with a certain amount of doubt, because bacteriological experiments, and experiences, are altering every day, and while some light would probably come from such an examination, it should be received with caution.

8220. So far as clinical differences between this form of fever with enlarged glands and plague are concerned, I think the only point that you have been able to state, as constituting a difference, is the condition of the tongue?—I say that, and I say another thing (and I maintain that this is a crucial point) and that is, the communicability of plague and the non-communicability of malignant fever.

8221. Consider the clinical features only, not the history of the infection. With regard to the clinical features, is there any other symptom but that arrived at from an examination of the tongue?—In the majority of cases of plague you have excessive vomiting; that is a feature which was noticed constantly, that the vomiting was very distressing, whilst in these cases of malignant fever, vomiting was almost an absent feature. It was present in some cases, but in the majority of cases it was not so.

8222. Let us take the tongue, which seems important What do you consider are the diagnostic conditions of this tongue?—McCabe Dallas I take as a high authority in this matter, and looking through the cases, I see that in Bombay, he pointed to the thickness of the tongue, its being thick and swollen, a doughy-like tongue, with thick brown fur, and often patchy, that is, with patches of the fur peeled off; whereas in cases of malignant fever, the tongue was much in the condition of an old standing tropical diarrhœa, the mucous membrane had begun to be denuded and the tongue looked raw and beefy. I am speaking of cases of malignant fever.

8223. You are quite well aware that in all acute diseases the appearance of the tongue varies, not only from day to day, but also in individual cases?—Take for instance the characteristic tongue by which you are guided clinically in typhoid; that changes only with the stages of the disease. If you take malignant fever you have almost one type of tongue. I am talking of this particular form of septic fever with glandular engorgement, which I have frequently seen in Calcutta, a raw tongue, and glistening, just as though the membrane had been denuded by some acute septic change of an acrid character, which had caused the denudation of the membrane.

8224. Have you not seen tongues partly denuded in the cases of plague which you have seen in Bombay which have these last characteristics?—I did not see a single case of a glistening tongue at all among the whole crowd. I saw tongues that were swollen and thickly furred, and tongues that were furred and swollen and patchy, but I never saw a clean, glistening, raw tongue like the tongue of long standing intestinal catarrh, where the membrane had got denuded and where the tongue is a simple indication of the state of the alimentary canal right through.

8225. I think it is recognised among those who have seen cases in Bombay that the condition of the tongue does vary?—Manson speaks of it in his book, but I only referred to what I have seen. I did not see cases with clean glistening tongue, but what you say Manson has put down as one of the characteristic clinical features.

8226. It would be extremely difficult therefore to distinguish this malignant fever from plague cases?—It is difficult.

8227. I think you emphasized the fact that the diagnosis is almost impossible, except from a knowledge of two facts: one is the bacteriological condition of the blood, and the other the infectiveness?—Quite so, plague is contagious.

8228. You referred to your student days: have you lately seen cases which come under this type of fever, which in many respects is malignant, associated with enlargement of the glands?—I have seen it occasionally. I know that hardly three or four months go by in my own practice without my seeing it. It is chiefly among native patients who are brought to me in palkis or on beds, poor people, who cannot afford to pay for advice; they have been brought in to see me. I always enquire where they have come from, and I invariably learn that they come from these bustees, where there is absolutely not the slightest regard for sanitation, and where the sub-soil is utterly putrid.

8229. That is not an important fact with regard to it not being plague, because plague occurs in such places?—Yes.

8230. When did you last see such a case?—About six months ago.

8231. Not since then?—No. I remember seeing a case about six months ago, probably just about that time of this plague scare. I tried to trace this man at the time or trace some of his relatives, because one of them had been a coachman of mine, but I could not find out anything further about the man.

8232. (*Mr. Hewett.*)—Are we to understand that your opinion is not only that there has been no plague in 1898, but that there has been none in Calcutta during the period which you have practised here?—Well, I cannot help saying that I am very strongly impressed that plague is contagious. Plague once coming into a spot is very rapidly communicable, and would spread. I take it that these cases which have occurred have been cases of malignant fever marked by absolute non-contagiousness. It is an undeniable fact that we have not even had a modified epidemic of plague. These cases have been cases of malignant fever, and not cases of plague.

8233. Is your answer to my question in the affirmative?—My answer would be, at no time as far back as I remember have there been any cases of real plague in Calcutta.

(Witness withdrew.)

CAPTAIN A. H. BINGLEY, I.S.C., called and examined.

Captain A. H. Bingley.

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8234. (*The President.*)—I believe you have been occupied on plague duty in Bombay?—Yes.

8235. (*Mr. Cumine.*)—You went on plague duty in January 1898?—Yes.

8236. At first you were in charge of the camp at Bandora, a station a few miles north of Bombay, were you not?—Yes.

8237. The object of that camp I think was to detain under observation for ten days travellers going north from Bombay?—That was so.

8238. Have you any important facts to give us observed whilst you were in charge of this camp, for instance how many plague cases developed in the camp?—I was in charge of the camp for about a month, and in that month, to the best of my recollection, there were about 20 plague cases discovered from among the passengers we took out of the trains.

8239. Have you any notion out of how many thousand passengers that would be?—I think during the month I was in charge of the camp something like 3,000 people passed through. But I have no figures with which to verify this statement.

8240. Have you anything to tell us about the period of incubation?—Yes, among the people who developed plague in the camp whilst I was in charge was a woman who developed plague on the 10th day. That rather seemed to show that ten days was not quite a safe limit.

8241. Did you give each family a separate hut?—Yes; as far as possible we gave each family a separate hut, and in the case of single men, we put the same castes together as far as possible.

8242. Had any other plague cases developed near this woman?—No.

8243. Do you think she could have got infected in the camp?—I do not think so.

8244. After about a month of that you went to Bombay, I think?—Yes, I was placed in charge of a district.

8245. "C" Ward, was it?—Yes, which includes the Dhobi Talao, Market, Fanaswadi, Kumbharwada, and Khara Talao sections of the city.

8246. How long did you remain there?—Until the end of August.

8247. Was the ward already infected when you got there?—Yes, plague was very bad, it was just at its worst.

8248. Did you notice any mortality amongst rats?—I did.

8249. Could you say whether rats got ill first, or human beings?—I could not say from personal knowledge. They appeared to be both dying simultaneously when I got there.

8250. What are the set of people amongst whom the disease was commonest?—It was pretty well divided when I first went down, but on the whole I should say it was commonest among the Ghati labouring class.

8251. They work as porters at the quays?—Yes, and at the Railway stations, in the Docks, and on the Bandar.

8252. They belong to the Deccan, do they not, and come down to Bombay for work?—They do.

8253. Are they the chief inhabitants of the crowded chawls?—Yes. They are nearly always bachelors, they live in very crowded chawls, and those chawls, I noticed, were those which were most infected with plague.

8254. Whilst you were in Bombay I think the policy as regards the removal of patients and contacts was rather modified?—It was.

8255. In the month of March?—Yes.

8256. Before the modification took place, what was the first policy?—The first policy was to remove the patient to hospital; to remove the contacts to a contact camp; and to disinfect the infected room thoroughly, and close it for ten days afterwards, sometimes longer.

8257. Have you anything to say with regard to house searching?—House searching was in force when I first went on plague duty. It was abandoned almost immediately afterwards. We then got our information from native gentlemen working in Volunteer Committees; from the Health Department; and from the Police.

8258. What was the change of policy as regards the removal to hospital and the segregation of contacts?—As regards the removal to hospital, we were told to exercise our own discretion, and in case where a patient lived in a clean house, where there was no overcrowding, and where the sanitary conditions were fairly good, we were allowed to have a patient treated in his own room. With regard to the removal of contacts we were also given discretionary power. If a family was fairly respectable, and the place was not overcrowded, and there was good accommodation in a house, the contacts were allowed to be segregated in that house, the District Officer keeping them under observation and visiting them every day. The removal to contact camps was reserved for cases of extreme overcrowding, and of very poor patients.

8259. In the early days, when there was a house to house visitation, can you tell us whether the result of that visitation was good: tell us what were the good results, and what were the bad results?—That depended very much upon what class of people we were dealing with. Speaking generally, I think that house to house visitation is not a good thing. The people dislike it, and the more energetic the District Officer becomes the more will the people attempt to elude the results of his work by removing their sick and by going from one district to another to escape him. We could not get any voluntary information at all: at any rate it was very rare.

8260. What was the result of the universal removal of patients to hospitals, and the knowledge by the people that patients were usually removed to hospitals, in the early part of your duty in Bombay?—The people never like removal to hospitals. For one thing, so many people died on the way, or immediately after admission. This was due, I think, generally to the fact that we got information too late, and cases were more or less *in extremis* by the time we removed them. After the change of policy, whenever we found any one really ill, or dying, we allowed him to stay where he was, without being removed.

8261. What was the result of the knowledge that contacts would be taken to the segregation camps: did you generally get the contacts?—No, I cannot say we did. We did in some cases, but not in others. It was extremely difficult in a crowded chawl with any number of people living in it, to find out who were actual contacts, because the occupants of the room in many cases used to take lodgers, and many of these lodgers paid an anna, or two annas, to be allowed to sleep there during the night, and went away again the next morning. You have no trace of these people at all.

8262. Did you find that the disappearance of these contacts led to further centres of infection being set up in the town?—I do not think so, because, as a matter of fact, the plague diminished gradually. I joined plague work at the time when it was at its worst. As time went on it grew less and less.

8263. In those cases where you left people to be nursed in the house, did you find bad results ensuing from it?—No, on the contrary, good results. The disease did not spread, and the confidence of the people was restored. I found that the more we pursued that policy the more readily people came forward and gave information of fresh cases.

8264. When you left a man in a house, what did you do in the way of disinfection?—When we left a man in a house, what we generally tried to do was to remove the patient to a clean, airy room. Then the room he had occupied was very carefully disinfected, and we went on disinfecting it day by day. Latterly I used to send a man with a watering-can filled with perchloride of mercury solution to sprinkle the floor of the room in which the patient had been. The room he was actually in was also disinfected, so far as the floor was concerned, in the same way. The Medical Officer used to accompany me and examine the contacts to see if they were all right.

8265. Did you provide the patients with beds?—No.

8266. You did nothing in that way?—No. We used to burn their bedding. I do not think I remember ever coming across any sick people that were not already provided with beds except a few road-side cases.

8267. What disinfectant did you use?—Perchloride of mercury.

8268. Do you believe that that, repeated several times over, is an efficient disinfectant?—I think so, as long as there is a responsible officer to watch the disinfection. I had a very good subordinate, a retired Sergeant-Major, who used to superintend that part of the work when I could not do it myself. He did the work very well.

8269. I suppose the character of the floor has a great deal to do with the easiness or difficulty of it?—Very much. I found that the disinfection of stone floors was very much more successful than the disinfection of ordinary cow-dung floors. I also found that the disinfection of a large building was much more effective if carried out with fire-engines than if carried out by an ordinary hand pump.

8270. Did the people raise great objection to being turned out for a few hours, in order that their rooms might be disinfected?—No, they did not. As a general rule, I had no trouble with the people at all, as long as I was there myself, or one of the officers was there. If, however, the work was left to a subordinate, there was occasionally a difficulty. I used then to be sent for, and I had to go and arrange matters.

8271. Would that be because they were afraid of their things disappearing?—I think partly that, and partly because the subordinates would threaten them with various things unless they gave them compensation of some sort.

8272. Do you think that the entire evacuation of big towns is impossible?—I think so. Segregation, the removal of the sick, and a modified cordon system, is all very well in the case of a village, or a small town, because you can render it effective; but in the case of large towns like Calcutta, or Bombay, if you had a whole army at your disposal, you could not make it effective; and as you cannot make it effective, it is better not to attempt it at all, because the more you enforce measures which people dislike, the more will they run away from one place to another, and in that way spread the disease.

8273. Would you try and get as many as possible of them out of the infected quarter into camps?—Yes, I am a great believer in that. I consider from what I have seen at Bombay that the reason why plague remains in the town, and all efforts made by the authorities to get rid of it have been practically useless, is that the house accommodation is so very defective. Bombay is very over-crowded. All sorts of new industries have been springing up within the last few years, cotton presses, mills, and so on, and the people employed in them have to be accommodated near their work; house accommodation has not increased in proportion to the population, and the consequence is that landlords, in order to increase their rents, have taken advantage of the situation and have sub-divided their rooms. A room which originally had plenty of light and air, is now split up into three or four portions by partitions, and the inner ones have neither light, nor air, nor ventilation, and they are thoroughly insanitary. If you close such a house, you increase the evil, because the people you turn out have to live somewhere else, and that causes over-crowding in another place. The only alternative is to have Municipal camps built on sites near the centres of work, and to give the people facilities in the way of free passes by rail or tram, so that they can get to and from their homes easily. These camps were tried in Bombay, but they were not considered successful, and I think that this was due partly to the fact that they were started rather too late, and partly because natives dislike all innovations. The experiment had not a fair chance. In my own district I had a large health camp. I was able to fill it with people from the poorest parts, and I was even able to collect two rupees a month rent for each hut. They paid this willingly. I never had any trouble in collecting the rent, and on that scale it not only paid all expenses, but allowed for a fair rate of interest on the original cost of building.

8274. Do you think as regards these camps that are some way off from the people's work, that a free ticket by tram or railway might be included in the rent they pay?—I think the great thing is to have one *inclusive* charge. Supposing the Municipality said "We will charge you for this hut, and for a season ticket to and from your place of work so much," the people would pay—very willingly: I know that from actual experience.

8275. Although there may be difficulty in getting people to go into a camp at first, is it not the case that they get to like it so much, that there is a difficulty in getting them out of it again?—It is absolutely so. In one or two cases where I had to turn out people for various reasons, they petitioned the Municipality against the hardship of being removed from the camp.

8276. And that in spite of paying rent?—Quite so.

8277. Have you any suggestion to make in regard to the fact that plague always seems to originate in the export grain quarter?—It struck me as remarkable that plague should become most serious just after the cessation of the export grain trade. There is a big export grain trade in the hot weather months. At that time plague goes down practically to zero. Immediately after the commencement of the monsoon, plague begins to rise again—that is, at the time the export grain trade ceases. I cannot help thinking that the rise is more or less due to the movement of rats in connection with the grain trade. Rats congregate where they find most grain. Grain is stored in the Bandars, in the Mandvi district, and other localities near the Harbour. As long as the grain trade is going on, the rats stay in these localities because their food is there, but from the moment the exports cease, these rats are deprived of their means of livelihood, and they are obliged to go into other parts of the town in search of food. They begin in the district where they are, *i.e.*, Mandvi, and every year Mandvi is thus the focus from which infection spreads. We can infer now, from the plague charts published in the Plague Committee's* reports, that the movements of rats are more or less from south-east to north-west, which is exactly the way the districts in Bombay become infected.

8278. With regard to patients in thickly-crowded chawls, what did you do with them latterly?—I used to leave the patient in his room, to be treated in that room; the remainder of the inhabitants of the chawl I allowed to remain there, but the contacts who were actually with the patient used mostly to go to a contact camp. In dealing with these cases, each case was treated on its individual merits, and the action taken depended upon what sort of house it was, what sort of people were living in it, and what were their occupations.

8279. (*The President.*)—How does that modify it: in what respects did these conditions modify your actions?—Supposing a house was a large, well-ventilated modern building with a good water-supply and good drains, it would not be as necessary to remove people as if it were an ill-ventilated, crowded and dirty one.

8280. Were there any chawls which conformed with the second of those conditions you have spoken of?—Yes, some of the new buildings would be all right if they were only kept clean.

8281. (*Mr. Hewett.*)—Can you tell us the number of persons you accommodated in your camp where the people paid rent?—The accommodation, as far as I remember, was for 1,500.

8282. (*Prof. Wright.*)—Have you made any observations upon the migrations of rats?—I cannot say I have.

8283. They generally go from south-east to north-west?—Yes. I have arrived at that conclusion from studying the maps which are in the Reports of the Plague Committee.*

8284. The plague spreads from south-east to north-west: you have studied that?—Yes, that is my opinion as regards Bombay.

8285. What makes you infer that rats travel in that direction?—It is entirely an inference of my own based on the previous conclusion.

8286. That the rats travel because plague has gone there—that the rats remove into the plague infected district?—No, my conclusion is that owing to infected rats travelling in search of food plague also travels in this manner: but this is not the only source of infection.

8287. How does one know that rats naturally travel in that direction: you say plague travels, and I ask you how do you know that plague travels?—By the charts.

8288. Rats must travel after the plague?—I do not say that. I think rats probably travel in advance of it.

8289. How do you know that the rats move at all?—By the number of dead ones you find in freshly infected districts.

8290. Is there a census of rats according to the districts they are found in? We have had so much talk about rats, we are trying to get at actual facts. When rats are found there, is a map kept of where the rats are found?—Not that I know of.

8291. You think there are no definite facts about these rats?—No. Nothing conclusive.

8292. You have not got them at any rate?—No.

8293. (*The President.*)—Your district is entirely a poor one?—Not entirely, the Parsees living in the districts are fairly well-to-do people.

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* *Vide* Report of the Bubonic Plague in Bombay by Brigadier General Gatacre, C B., D. S. O., Chairman, Plague Committee, 1896-97, and Report of the Bombay Plague Committee on the Plague in Bombay from the 1st July 1897 to the 30th April 1898, by Sir James Campbell.

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8294. Do the houses vary much in their characteristics?—Yes. The Parsees had a health camp of their own, belonging to their own community, on the sea-front, and they went to it very readily.

8295. Do the habitations in your district vary much in their characteristics?—Yes, they are very varying.

8296. What sort of variations?—For instance, in the Fanaswadi District, which is inhabited chiefly by Parsees, there are four or five storeyed houses—the rooms are large and not as a rule overcrowded; the Dhobi Talao District is in parts very poor, and the overcrowding considerable; the Kumbharwada and Khara Talao Districts are occupied chiefly by the labouring classes, most of the houses being lodging-houses, and the overcrowding is very great. The houses there are of a very inferior type. There are no plinths at all, and the ground floors are below the level of the streets. The rooms are very dark, and have all been sub-divided by partitions, so as to make one room into four or five. The inner rooms have thus no windows, and no light or air. In fact, in many rooms, one would have to use lamps night and day.

8297. Did you find any relationship between the number of plague cases, and the nature of the habitations?—Yes.

8298. What was the relationship?—As a general rule, where the houses were very bad, plague was very bad.

8299. Have you seen many cases of plague in the best of the houses?—No.

8300. Some?—Yes, but they were comparatively few.

8301. You spoke of evacuating certain places, how long did you wait before allowing the people to return?—Ten days was the minimum: in some cases we used our discretionary power and kept buildings empty for a month and more. If we knew that the house was a bad one, and that it would be overcrowded the moment the people came back, we used to keep it closed much longer for that reason.

8302. Supposing you evacuate one of these dark insufficiently ventilated houses or rooms, do you allow the people to go back before you put them into a proper sanitary condition?—We used to disinfect the house thoroughly from top to bottom, but structural alterations could not always be carried out.

8303. Sometimes, I understand, you detain a patient in some rooms of that kind?—Yes, but rarely.

8304. How did you treat them in a dark room: were they treated there?—Yes.

8305. Who attended them?—One of the District Medical Officers. Supposing a patient was in a very bad room—one of these little cupboard rooms—in most cases we used to remove him to a more airy room, but of course that was always on the understanding that the whole of the house would be disinfected from top to bottom before it would be allowed to be re-occupied.

8306. In some cases you did not do that, but left the Patients in such a room?—Yes, in some few cases; but it was simply a question of local conditions. There was no fixed rule: we had to use our judgment.

(Witness withdrew.)

Mr. C. L. Griesbach, C.I.E., called and examined.

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8307. (*The President.*)—You are a Fellow of the Geological Society?—Yes.

8308. And also a member of several other Societies?—Yes.

8309. I believe you are Director of the Geological Survey of India?—Yes.

8310. You have been kind enough, in compliance with a request made by the Commission, to prepare a statement on the distribution of plague cases, and the relation of that distribution to the geological formation of Hindustan?—Yes.

8311. It would be convenient if you would read your statement?—Casting a cursory glance at the geological map of India with reference to the distribution of known plague cases which have occurred in India within the last three years it will at once be perceived that this distribution may be roughly grouped into cases which have been detected within the large extent of alluvial land which stretches from the Delta of the Indus river right across India to the Bay of Bengal, and into the group of cases which occurred within the peninsula proper lying south of the Vindhian range.

(*Alluvium.*)—Strictly speaking all the reported cases of plague must have occurred on land which we may term alluvial, *i.e.*, on land formed either by detritus deposited by flowing water or by the decomposition *in situ* and probable re-arrangement by water of the rocks forming the ground overlaid now by these recent deposits. The latter, however, are comparatively speaking of but shallow depths within the wide expanse of the central and southern portion of the peninsula, whilst the great Indus and Ganges alluvium is of absolutely unknown depth and forms as far as is known an almost unvarying complex of sands, clays and pebble beds right across India, and in viewing the composition of the soil with reference to plague distribution the possible source of the rocks which have furnished the material of the subsoil, the great Northern Alluvial region of India may be considered as the original formation and the underlying rocks (quite unknown to us) may be entirely neglected.

(*Southern Peninsula.*)—It is different in the more southern regions of the peninsula. Geologically speaking it is composed *chiefly* of crystalline rocks of the gneissose group with certain intrusions of eruptive rocks, overlaid in places by strata of the oldest geological systems, which have been classified into various systems, amongst which we may note the "Dharwars," "Cuddapahs" and "Aravalli" systems as the principal ones with which we shall have to deal in this paper. With reference to the plague cases, none of the latter systems form extended areas.

(*Deccan Trap.*)—Overlying this gneissose area we find a huge spread of more recent igneous rocks, which we commonly call the "Deccan Trap." The greater part of the Bombay Presidency with parts of Central India, the Central Provinces and the Nizam's Territories are covered by this trap flow, of which, however, we see only a small portion of its original extent. We have proofs that these igneous flows once covered all the country right across the Indian Ocean, touching Arabia on one side, and East Africa on the other. This trap outflow occurred at a time near the base of the eocene system, and when the principal folding of the Himalayan ranges were taking place.

(*Laterite formation.*)—Almost the entire area of the trap is covered by a varying depth of a ferruginous formation, called laterite, which has been classified into groups, but is on the whole of more or less the same structure throughout. Its formation is not certain, but it may be assumed that a great deal of it has been formed *in situ* by the decomposition of the underlying rocks. The laterite occurs, spread as a cap over the crystalline rocks and Deccan Trap, and large areas of the latter in India and in other countries are so covered. *In connection with the plague I may say that it forms the immediate base for such of the recent beds on which plague infected localities are found.* The distribution of the laterite is practically the same as that of the trap and crystalline formations, but inasmuch as the laterite forms one of the sub-recent deposits, its exact boundaries have, except in a few cases, not been entered on our geological maps, and therefore I have had to neglect it in the following list of localities. But it may be broadly stated that at least in the cases of "Deccan Trap" and partially in that of the crystalline areas, the laterite forms a cap of varying thickness below the soil.

I have had to preface my remarks on the distribution of the plague cases in India by this rough sketch of the outlines of geology as otherwise the following list of places or their geological formations would be quite unintelligible:—

LIST OF PLAGUE LOCALITIES.

Localities on purely alluvial soil, and within the area of the Indus and Ganges alluvium:—

SIND—Karachi. Shikarpur. Hyderabad.

PUNJAB—Jullundur District. Hoshiarpur District.

NORTH-WESTERN PROVINCES AND OUDH—Saharanpur District.

Plague localities within Deccan Trap and Crystalline areas and *recent* ormations derived direct from the former rocks:—

Localities.	Formations.
BOMBAY PRESIDENCY AND STATES.	
Bombay City	Deccan Trap.
Poona City	Ditto.
Dharwar District	Gneissose rocks with Dharwar transition rocks and Deccan Trap.
Satara do.	Deccan Trap.
Belgaum do.	Deccan Trap and rocks of the Cuddapahs.
Kolhapur State	Deccan Trap.
Thana District	Ditto.
Cutch State	Jurassic limestone and sandstone; cretaceous limestone, etc.; Deccan Trap and fringed by recent beds near coast.
Surat District	Recent deposits of marine origin; north-east tertiary beds; East Deccan Trap.
Baroda State	Alluvial; south of East Arravallis and crystalline rocks; south mostly Deccan Trap, laterite.
Poona District	Deccan Trap.
Sholapur District	Ditto.
Nasik do.	Ditto.
Kathiawar	Deccan Trap, fringed by tertiary beds and recent sands, etc., near Coast.
Kolaba District	Deccan Trap.
Palanpur State	Gneissose rocks and Arravallis with recent sands, etc.
Ahmednagar District	Deccan Trap.
Bhor State	Ditto.
Ratnagiri District	Ditto.
Bijapur do.	Ditto.
Broach do.	Recent south-east upper tertiary sandstone.
Aundh State	Deccan Trap.
Akalkot State	Ditto.
Khandesh District	Ditto.
Sachin State	Recent (on Deccan Trap).
Kaira District	Recent Marine deposits.
Ahmedabad District	Do. do. do.
Janjira State	Deccan Trap.
Rewa Kantha State	Ditto and Crystalline rocks, Alluvium in valleys.
Panch Mahals District	Not yet surveyed by G. S. I.
Savantvadi State	Gneiss and Deccan Trap.
Kanara District	Gneissic rocks and Dharwars.
Daman (Portuguese)	Deccan Trap.
CENTRAL PROVINCES—	
Wardha District	Deccan Trap.
MADRAS PRESIDENCY—	
Anantapur District	Crystalline (Gneiss, etc.), bounded east by rocks of the Cuddapah system.
Salem District	Crystalline rocks (Gneiss, etc.).
North Arcot District	Crystalline (Gneiss) with laterite.
Bellary District	Crystalline (chiefly Gneiss) with rocks of the Dharwar system.
CENTRAL INDIA—	
Khandraoni in Gwalior State.	Arravallis and Vindhians on gneiss; alluvial deposits in valleys between.
HYDERABAD STATE—	
Lingsugar District	Gneiss and Dharwars.
Naldrug do.	Deccan Trap.
Aurungabad District	Ditto.
Gulbarga do.	Ditto.
Bidar do.	Ditto.
RAJPUTANA—	
Sirohi State	Crystalline (Gneiss, etc.), with rocks of Arravalli system.
MYSORE STATE—	
Bangalore City	On Gneiss. All localities within this state gneiss with patches of rocks of Dharwar system and intrusions of igneous rocks. Much laterite.

From this list of localities it appears that by far the largest number of plague cases have occurred on soil covering Deccan Trap and crystalline rocks, and only a very small number on the great alluvial belt stretching from the Indian Ocean to the Bay of Bengal. I may mention that the former formation roughly coincides with the distribution of laterite deposits.

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The total number of cases are as follows, between September 1896 and November 1898:—

On Trap and crystalline rocks	150,929
On the Indus-Ganges alluvium	12,936
GRAND TOTAL	163,865

Of this grand total the cases which have occurred on the great Indian Alluvium form only 7·88 per cent.

At first sight this appears very striking and seems to point to the trap and crystalline area as being specially adapted to the spread of the disease, but in reality there is a more probable explanation for these figures at hand. A look at the geological map of India will show that Bombay is situated near the centre of the western margin of the great Deccan Trap plateau. When the exodus of the scared population began after the outbreak of the plague in 1896, the refugees naturally moved into all directions and spread themselves fan-like over the adjoining country, and this happening to be all composed of Deccan Trap, and beyond it of crystalline rocks, the overwhelming majority of cases on these formations seems easily explained.

It has been shown that so far at least it has not been conclusively proved that *soils*, without the intervention of man, spontaneously develope diseases (see Dr. H. A. Griesbach, Propadeutik, p. 486), but, on the other hand there are abundant evidences that the spread and tenacity with which certain epidemics cling to localities are influenced by the geological formation on which they first appear, and this may possibly be explained, not by chemical or other characters of the underlying rocks, but by the degree of porosity of the immediate soil. The deep-seated rocks underlying the soil can scarcely influence the disease, for the organic matter or bacilli generated during the epidemic could not sink to such depths without complete chemical change, but in the case of Western India, it may be remarked that the soil is generally very thin, and rests frequently direct on laterite deposits, which are amongst the most spongy and generally porous rocks known. In such cases it may well be that the direct sources of the epidemic may sink some considerable depth into the underlying rock, but this would have to be proved.

I may here mention that Dr. Pettenkofer has drawn attention to the relation between the outbreak of cholera in Malta and Gozzo and the porosity of the rocks forming these islands (see Zeitschrift für Biologie, Volume VI; see Griesbach *ibid*, p. 483), and that Hirsch, (Handbuch der histor. geographischen Pathologie, 2nd edition, 1881, Volume I, pp. 193 ff,) has proved that epidemic outbreaks have occurred on soil which had never been disturbed by man before.

The other day I got a book to which I have referred in my foregoing statement—Hirsch's Historical and Geographical Pathology,—and he refers to two other authors who have connected malarial fevers with the laterite of India. All one can say is, I think, that this epidemic, like other epidemics, might be connected with the special porosity of the soil—other conditions being given, such as actual importation of the germ. So far there is no evidence that plague could be specially generated by any of the formations in India, because it occurs practically in all soils, but also at the present moment in the soil directly covering laterite.

8312. Both of these being sufficiently porous to fulfil that condition?—Yes, more so than alluvium. Of course it is conceivable that some alluvium would be exceedingly porous, such as in the Nile valley for instance. Unless one has an absolutely accurate account of the particular alluviums, it is impossible to say:—for instance, here in Calcutta, immediately below the surface sands, there is a water-logged soil of clay, which would stop any surface drainage from sinking deep into the ground. One could not apply that argument to the whole of Calcutta, or to the whole of the Ganges alluvium, because we have no knowledge of it.

8313. What is your general deduction from your examination of this matter?—Beyond these facts I do not deduce anything. I must accept the general medical opinion that geological formations, as such, have nothing to do with the distribution of epidemics. I have no medical observations to offer myself, whatever my private opinion might be.

8314. We should like to have your private opinion?—My private opinion is not based upon facts; it is mere sentiment. I do not believe, for instance, in the germ or bacillus being the origin of the disease, but merely a symptom of it. With regard to that I have no evidence to offer: I am not a medical man. So far, most of the

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plague cases have occurred on crystalline and trap rocks which are covered by this laterite, which not only by myself, but by others, have been put forth as a possible malarial sub-soil.

8315. Could you explain the distribution otherwise than from geological conditions?—I say that the natural explanation of the fan-shaped spread of plague, with Bombay as a centre, is that the population of Bombay spreads out in all directions across India. That is the natural explanation, but it coincides here with the distribution of the laterite-supporting rocks of India.

8316. (*Prof. Wright.*)—I understand that the soil was made by the wearing down of rocks: is that so?—In most cases.

8317. Is this laterite a soil which is produced by the wearing down of trap rock, or is it itself a separate variety of rock?—It is the prevalent opinion that this laterite is formed *in situ* by the chemical disintegration of the rock and the re-cementing of it. We distinguish high level and low level laterite in India. It is an artificial distinction, really, but it is probable that some of the low level laterite has been bodily carried down as alluvium from high levels, and has been accumulated in the valleys, but it is chemically practically the same rock.

8318. Is this laterite derived from the trap, or from the crystalline rock?—From both. It is very thick over the trap, because all the constituents of the trap contribute towards laterite, alumina, iron, and so on. The only distinction between the laterite of the trap, and that of the crystalline rocks, is that the laterite on trap is mostly richer in alumina, and the other is richer in silica. Both are exceedingly porous.

8319. Let us assume that the plague bacillus is not a symptom of plague, but the cause of it, and that it leaves the body of the plague patient and it gets on the ground, and that it is picked up thence and thus infects other people. Further let us keep in view that we find by experience that when we put bacteria into distilled water they get very rapidly killed, whereas they survive when they are placed in diluted solutions of salts. Can you tell us in what way water which passed through the laterite would differ from water which passed through other soils?—I fancy it would chiefly differ in containing more iron,—roughly speaking, about 30 per cent. of peroxide in the laterite, and the laterite containing this iron, and the water flowing through it, would dissolve a certain amount of iron in it.

8320. With reference to Bombay and Calcutta; in Bombay, as far as we can see, the plague bacilli survive on the soil. When they get on to the ground here in Calcutta they die. Is there any difference in the mineral constituents which the water would extract from these two soils—any broad distinction?—I have no assays of the water here: I do not know at all. The probability is that Bombay water does contain a certain amount of iron, if that helps the bacillus at all.

8321. I do not mean the water the town is supplied with; I mean the water that is in the soil. I want to know whether it would extract different chemical elements in Bombay from what it would from the soil of Calcutta?—I am not aware of any positive facts known about it.

8322. We hear that plague is endemic in Kumaun, and various other regions of the world: have you any geological knowledge of what sort of rocks there are there?—In Upper Kumaun it is chiefly crystalline rocks, and in Lower Kumaun, nearly all crystalline rocks.

8323. From this chemical standpoint, do you know what the water would extract?—Very much the same substances as it would down in Dharwar or Mysore; in fact precisely the same as the Mysore water.

8324. Can you tell me what is meant by a black-cotton soil, and can you tell me in particular what chemical element a water would extract from such a soil?—The Regur or black-cotton soil is a highly argillaceous and somewhat calcareous soil of great fertility, which absorbs water to a large extent, increasing much in volume in such case. During the dry seasons the ground composed of cotton soil opens out into numerous cracks and fissures, into which any surface drainage naturally may penetrate deeply during the first rains. Its chemical composition has not been studied very closely. An analysis of a dried sample gave:—

Silica	43·2
Alumina	20·3
Carbonate of lime	16·0
Carbonate of magnesia	10·2
Oxide of iron	6·0
Water and extractives	4·3
	100·0

An analysis made in the Geological Survey Office has given the following composition of the *soluble* portion of black cotton soil; the figures represent the mean of seven undried samples, the balance being insoluble residue chiefly of magnesia and alkali: traces of sulphuric acid were found in three of the samples:—

Organic matter	8·41
Water	8·19
Oxide of iron	9·49
Alumina	7·63
Carbonate of lime	5·0·0
Insoluble residue	61·28
	100·00

8325. (*Mr. Cumine.*)—There is a great deal of laterite in Ratnagiri is there not?—Yes, thick layers on the top of the trap.

8326 There has been hardly any plague in that district, I think?—Some cases have been mentioned, I do not know how many. I do not wish it to be understood for one second that the laterite has anything to do with plague, but laterite being extremely porous, medical men have established the fact that porous soil is a more favourable soil for epidemics to spread on; and I have distinctly mentioned in my statement that there is no proof or evidence that geological formation has anything to do with the spread of the epidemics beyond the different physical characters attaching to various formations, some being porous, others being less so, some containing chemicals which may be favourable to pathological formations.

8327. (*The President.*)—You have come to the conclusion therefore, with regard to plague distribution, that it may quite well be explained by human communication from Bombay?—Quite so; there are no observations to show otherwise.

(Witness withdrew.)

DR. MAHENDRA LAL SIRCAR, C.I.E., called and examined.

Dr. Mahendra Lal Sircar.

4th Jan. 1899.

8328. (*The President.*)—I believe you are a practitioner here?—Yes.

8329. What is your medical qualification?—I am a graduate of the Calcutta Medical College, and M.D. of the Calcutta University.

8330. How long have you been in practice in Calcutta?—Since I graduated in 1860.

8331. (*Prof Wright.*)—You have seen no cases of plague in Calcutta?—No.

8332. Have you had any previous experience of plague: have you seen cases of plague elsewhere?—No.

8333. Have you seen cases which might have been mistaken for plague?—Some cases have come under my treatment which were mistaken for plague, but which recovered under the simplest treatment possible. Some people took flight from Calcutta and recovered without any treatment.

8334. Can you tell us something about these cases specifically: how many cases were diagnosed as plague?—I do not think more than half a dozen.

8335. Can you give us some details of each case?—They were so simple that it is not necessary to give any details: there was some fever with enlargement of glands.

8336. But they deceived somebody, did not they?—They were diagnosed as plague by somebody.

8337. Who diagnosed them?—I should not like to tell the patient's name, because he was frightened of being sent to the Isolation Hospital. He recovered in a short time.

8338. Who was the medical man responsible for the diagnosis in each case?—Is it necessary that I should mention it?

8339. We do not want the patient's name, but the medical man's name, who made the mistake?—If you insist upon it I will give it.

Dr. Mahendra Lal Sircar.

4th Jan. 1899.

8340. (*The President.*)—I think you had better give the name?—I saw his letter to the master of this patient that it was a suspicious case, and ought to be sent to the Isolation Hospital.

8341. (*Prof. Wright.*)—We want to know something of each case separately. Will you take one particular case?—I have not kept a record of any of these cases. They generally come in the course of my practice. I see poor patients gratis in my home when they come to me.

8342. You have only got a general impression: you have no specific case?—No.

8343. You are a homœopathist?—Yes, I am a homœopathist.

8344. You say you were a member of the Bengal Plague Commission?—Yes.

8345. Had you many meetings in Bengal?—We had some before the outbreak of the disease.

8346. Had you any meetings after the outbreak of plague?—I received no notice, and I cannot say whether there were meetings or not; but I myself did not receive any notice if any meetings were held.

8347. You have heard of there being cases of plague in Calcutta. Did you make endeavours to see these, and satisfy yourself that they were plague cases?—These cases were all taken to the Isolation Hospital, and consequently I could not make any endeavour to go to these hospitals myself without an authority from some one.

8348. Did you seek for authority?—I did not seek for authority to see these cases. I did not seek, for the reason I have given in my paper.

8349. What is that reason?—I cannot exactly define my position in the profession, but I do not like to meddle with people who have no faith in homœopathy, and who do not think I am a proper medical man.

8350. Why did you become a member of the Plague Commission?—I did not seek that appointment; I was appointed by Government to be a member of that Commission.

8351. But you did not want to undertake any duties that fell to you?—If any duties were given to me, I would have fulfilled them. I attended the meetings that were held. That was part of my duty.

8352. You have expressed a strong opinion that there was no plague in Calcutta?—I do not say that there was no plague in Calcutta.

8353. I understand your position to be this: that there are cases in Calcutta which might readily be mistaken for plague?—Some were mistaken; there is no doubt about it.

8354. But those mistakes might have occurred either because the cases were like plague, or because the people sent to diagnose them were incompetent?—It might be.

8355. Which is your view?—My view is that they were not cases of plague. These cases could not have recovered so rapidly under such simple treatment if they had been cases of plague proper.

8356. Do you think a reasonable man might have taken them for plague?—That is what I believed at the time—that most of these cases were mistaken as cases of plague, but were not in reality cases of plague.

(Witness withdrew.)

LIEUTENANT-COLONEL C. H. JOUBERT, I.M.S., called and examined.

Lieutenant-Colonel Joubert.

4th Jan. 1899.

8357. (*The President.*)—You have been practising here for some time, I think?—I have been practising in Calcutta for many years. I was Resident Surgeon at the Medical College for two or three months at the end of 1872; I was Resident Surgeon for a year at the General Hospital in 1874, and, with the exception of two years as Civil Surgeon at Darjeeling, I have been in Calcutta in Hospital and other appointments since 1877.

8358. You are familiar with all the types of disease in Calcutta?—Fairly so.

8359. You have encountered cases of plague here?—In my own practice I have seen but one case in April last.

8360. You have no doubt it was a case of plague?—I have no doubt.

8361. That is on account of the symptoms?—On account of the symptoms and the termination.

8362. Will you give us the details of the case?—I was called in to consultation by the native doctor in charge on the 26th April, to see a Jewish young lady in Ezra Street. The peculiarities of the case were great prostration with moderate fever and great enlargement of the right inguinal glands. The prostration increased, there was no delirium, and the case terminated rather suddenly with violent vomiting of blood, as reported to me. We had our suspicions at the time. I saw the case twice a day in consultation and I had no doubt at the end of the case that it was a true case of plague.

8363. Was there any bacteriological examination?—There was no bacteriological examination. The patient was a Jewess, and a *post-mortem* examination would have been impossible.

8364. Did you ascertain if this illness had been communicated from any other patient?—There were several cases of plague within a few days in that immediate locality. They are all on record. This is one of the first recorded cases. It was two or three days after this that the plague was declared to be endemic in Calcutta.

8365. You do not know if this patient actually came in contact with other patients?—I could not find out that she had been in such contact. The Calcutta Jews have a good deal of inter-communication with the Jews in Bombay, but this young lady had not been out of Calcutta for two years. The whole of the family and their relations are well known to me.

8366. Had she been in communication with any previous case of plague in Calcutta?—Not so far as we could ascertain; the cause of her illness seemed to be the locality. There was the usual story of dead rats.

8367. Preceding?—Yes.

8368. Is Ezra Street a good or bad part of the town?—It is good from a native point of view and bad from an European point of view. There are big houses inhabited mostly by well-to-do Jews and Muhammadans, but most of the basements are excessively dirty.

8369. This is the only case which you have actually seen?—It is the only case I have actually treated; I have visited cases in the wards of the Medical College.

8370. Were they under your care?—No.

8371. Have you seen any cases which at all resembled cases of plague?—In all the years I have been in Calcutta I have never seen cases resembling those which we have had to deal with this year.

8372. Have you ever seen any cases of lymphatic enlargement accompanied by fever?—I have seen a good many cases.

8373. Non-venereal?—Non-venereal. I had a case two years ago in one of my own servants, a gardener, which rather interested me. He got fever and a suppurating bubo in the left groin. There was no history of venereal disease. The man did his work until the bubo suppurated.

8374. And he recovered?—Yes; he went to hospital, the bubo opened, and he recovered perfectly. It did not seem a serious illness.

8375. Was the fever long continued?—No. The man came and showed himself to me every day.

8376. Have you seen any cases such as that recently?—No.

8377. Are you very likely to have seen such cases if there had been any?—I am less likely to do so than some of the other physicians in Calcutta, because my work during the past few years has become more specialised; I am not called in so much to purely medical cases.

8378. It is quite possible they may have occurred without your seeing them?—Perfectly.

(Witness withdrew.)

(Adjourned till to-morrow.)

At The Home Office, Calcutta.

TWENTY-FOURTH DAY.

Thursday, January 5th, 1899.

PRESENT :

PROF. T. R. FRASER, M.D., LL.D., F.R.S. (PRESIDENT).

MR. J. P. HEWETT.
PROF. A. E. WRIGHT, M.D.
MR. A. CUMINE.
DR. M. A. RUFFER.

MR. C. J. HALLIFAX (*Secretary*).

DR. J. NIELD COOK recalled and further examined.

Dr. J. Nield Cook.

5th Jan. 1899.

8379. (*The President.*)—You gave evidence on the 29th of December, I think ?—Yes.

8380. Since that time you have made some further examinations of the prophylactic fluid of M. Haffkine ?—I have examined 25 bottles.

8381. Would you kindly state what the results were ?—I found impurities in seven out of 25.

8382. How did you examine the specimens : what was your method ?—I diluted ½ c. c. of Haffkine's prophylactic with 2 c. c. sterile broth in an agar slope tube, and then noted if any growth occurred, and if it did, I made microscopic specimens, staining some with Grăm, and some with other stains. I found them all stained with Gram, and I also made some stab cultures in gelatine.

8383. Those specimens which you examined previously to the 23rd, I think, did not, so far as your examination went, show any bacteria ?—Previous to the 23rd, they did not.

8384. How do you explain that ?—Either that there were no bacteria there, or that the carbolic acid in the prophylactic prevented growth.

8385. In this instance you diluted the carbolic acid ?—In these last experiments I did.

8386. What kind of organisms did you find ?—There were none of the generally recognized organisms of disease. There was sarcina, which I should say is a harmless aërobic microbe, and there was what appeared to be a mesentericus fuscus, which occurs in air and water all about the place, and is not generally recognized as doing any harm, I think, and there was another long slender bacillus—I do not know what it was. Those three comprised everything I found.

8387. You did not anticipate that their presence would be injurious to the fluid ?—I do not think any of them could do much harm : whether any of them could cause slight transient inflammation or fever, I am not in a position to say, without experimenting with them, to settle the point.

8388. That is corroborative of your experience of inoculations, I think : is it not ?—Yes ; I never had more than moderate fever, and a certain amount of redness,—erythema.

8389. You will perhaps put in this table which gives the details of the instances in which you made these examinations ?—Yes.

Table showing the results of a bacteriological examination of Haffkine's Prophylactic.

	Number on bottles.	Result.	Microscopic appearances.
Nagpur.			
These bottles were obtained from Lieutenant Hammond, I. M. S. They were specimens of the same virus as that which was inoculated at Nagpur into Assistant Surgeon Hogan and his Hospital Assistant.	4748	*Nil.*	
	4746	3rd day numerous small colonies over one corner of the surface.	Sarcina.
	4746	Numerous colonies	Long slender rods stained with Gram; ends darker than body.
Calcutta— (Dr. Nield Cook)	3046	*Nil.*	
	3055	5th day diffuse growth	Fairly large bacillus with rounded ends stained with Gram. Large spore in middle.
	2939	*Nil.*	
	3032	"	
	2962	"	
	3049	4th day 30 discrete colonies upper part of slope ; diffuse growth at lower part near the broth at first, while afterwards tawny.	Long slender motile rods stained with Gram.
Dharwar— (Dr. Hornabrook)	4104-A.	3rd day 86 small discrete colonies over lower half of slope.	Long slender rods staining with Gram ; similar to 3049, but a few bearing spores.
	4843	*Nil.*	
	5035	Diffuse growth over lower part of slope	Long slender rods staining with Gram fairly large non-motile bacillus with rounded ends; long spore in centre; stains with Gram ; is like 3055.
Bottle marked suspicious	5060	*Nil.*	
	5339	"	
Bangalore— (Capt. Leumann)	4814		
	4475		
	4272		
	4470		
	4647		
Hyderabad—	5315	"	
(Col. Lawrie)	5338	3rd day about 50 small discrete colonies ; upper third larger ; irregular ones lower part of slope.	Fairly large bacillus with rounded ends ; stains with Gram ; medial spore ; similar to 3055.
Duplicates	5344	*Nil.*	
	5315	"	
	5338	"	
	5343	"	

Dr. J. Nield Cook.

5th Jan. 1899.

8390. You have also made some bacteriological examinations of plague cases, I think?—Yes.

8391. Have you made many?—In human cases I suppose I have made about 15 to 20 perhaps altogether, some of them alone and some with others. I did several cases with Major Bannerman. Then, in addition to that, I have seen cultures made by Major Green and Dr. Clemow, and others.

8392. And in how many of these cases did you get evidence of the existence of the plague bacillus?—In nearly all of them.

8393. Could you explain what method you employed exactly?—If a *post mortem* was done, I cauterised the surface of the gland and inserted a sterilised pipette, and sucked up some of the liquid matter, or semi-liquid matter, out of the gland, and spread it on agar slopes and put it in broth. I also took a bit of the gland, and rubbed it on a microscopic slide to make a specimen, and stained it. Then I generally took blood from the liver too in cases where there were no glands. I frequently obtained the bacillus, sometimes without doing a *post-mortem* at all, simply by cauterising the skin, and inserting a pipette into the liver. I have also made cultures from heart's blood and from lung stuff, and from sputum and other things.

8394. Have you inoculated any animals?—I have from my cultures, and I have killed animals with unmistakeable plague, and got the plague bacillus in culture from them and also under the microscope. I got the plague bacillus from them, and no other bacillus.

8395. Can you tell me what is the total number of cases of plague in Calcutta which you examined in this way, and obtained evidence of their being actually cases of plague?—I should think about 20 altogether.

8396. You have not thought it worth while to examine all the cases?—No; as soon as I thoroughly established to my own satisfaction the fact that there was unmistakeable plague in Calcutta, I considered it quite unnecessary. I had of course a great deal of other work to do, and I left that for the most part, and took up other work. I left the diagnosis of plague to my plague medical officers to make clinically.

8397. Over what period did these examinations, in which you got definite evidence of plague, extend?—Including those made by other men, which I have seen and watched over, the whole period from the first Kapalitola case extends from the 17th of April, I think it was.

8398. The first case was then?—Yes.

8399. In how many cases did you fail in getting evidence of the bacillus?—I have not got an exact record of that. I handed over most of my records, and I think that must have gone with them, but it was a comparatively small number. There were cases in which I failed.

8400. Suspected cases, which proved not to be plague?—There were cases in which I had very little doubt that it was plague, in which I failed. One is mentioned in the appendix to my report,* a case that I did with Major Bannerman.

8401. Cases which very closely resembled plague?—Yes; and occurred in a house from which I got the plague bacillus from other cases.

8402. (*Prof. Wright.*)—I understand the bottles of vaccine you examined were the bottles that were sent in for examination to the Plague Commissioner: is that not so?—They were sent from Bangalore, Hyderabad, Nagpur, Dharwar, and some of them were our own bottles here.

8403. Would you report separately on those. Six bottles were sent in from Bangalore: did you find any contaminating micro-organisms in any of those?—No micro-organisms in any of those.

8404. You had six bottles sent in from Hyderabad?—One bottle contained an impurity.

8405. Does that bear out Dr. Lawrie's statements that the vaccine that had been placed at his disposal was a putrescent fluid?—No; I should say it controverts it.

8406. How many bottles did you examine from Nagpur?—Three bottles, I think, from Nagpur.

8407. I understand that those were bottles supplied by Lieutenant Hammond, of the Indian Medical Service, and were the same bottles that were employed in the vaccination of Dr. Hogan and his Hospital Assistant which had given rise to undesirably severe symptoms?—Two out of those three contained impurities: one of them contained sarcina, the other contained long slender rods stained with Gram, and stains dark in the body.

8408. Have you put in a list of the cases of plague which were diagnosed bacteriologically by you?—No, because I have not got a list of the plague cases now; I handed all my records over when I gave up plague work.

8409. (*The President.*)—You have already explained that?—Yes.

8410. (*Dr. Ruffer.*)—Did you find in any bottles living micro-organisms which might be possibly mistaken for plague?—None in the least like it.

8411. Do you believe that it is possible for the plague bacillus to live in Haffkine's prophylactic fluid?—No; I know it is not; because even a weaker solution of carbolic acid than that would kill it in a matter of minutes.

8412. Do you think any pathogenic micro-organisms could possibly multiply in Haffkine's fluid?—None I am acquainted with. I have thought over that question myself, and gone through the whole list of pathogenic organisms, and I am of opinion that none of them could multiply in it. Some bacilli might remain alive in spore form.

8413. I think the plague bacillus does not form spores?—No.

8414. That objection would then fall to the ground entirely?—Yes.

8415. (*Prof. Wright.*)—We had it in evidence in several places that each bottle was tested by smelling it before it was used for the purpose of inoculation. Would that method have been sufficient to enable you to detect it without bacteriological examination?—No; in one bottle which was marked "suspicious" and in another bottle which was marked "rejected" I got no impurity whatever.

8416. In the bottles in which you got impurity was there a noticeable smell which caused it to be detected?—No.

8417. (*Dr. Ruffer.*)—Do you as Medical Officer of Health sign the ship papers? Who is responsible for that?—No that is the Port Health Officer.

(Witness withdrew.)

MAJOR GREEN, I.M.S., recalled and further examined.

Major Green.

5th Jan. 1899.

8418. (*The President.*)—Since we had the pleasure of seeing you before, you have had an opportunity of examining further cases of plague, I think?—No; not any certain case. There was one at that time, which I added to the list, in the Mayo Hospital, and since then I have not had any absolute case that I am sure of.

8419. Have you made any bacteriological examinations which you had not placed before us at that time?—I have made some.

8420. How many?—There are four cases which I have examined bacteriologically.

8421. Would you kindly tell us at what dates these examinations were made?—The first case is one, Jaisree. He died on August 12th. I obtained the cultures from Dr. Cook. It was not a case I examined myself. I inoculated a rat with cultures from this case.

8422. What was the result of the examination?—It died in 70 hours.

8423. Did you get evidence that it died because of the plague bacillus?—From smear preparations made from the groin there were diplo-bacilli in it.

8424. You satisfied yourself, I suppose, that they were plague bacilli?—I cultivated them, and they gave the characteristic appearances, and I obtained stalactites again.

8425. What was the second case?—This was a man named Beni Chowdri, and I have referred to this case in my evidence.

8426. You have before stated the result of your bacteriological examination of this case?—Yes. I inoculated a rat, and it died in 65 hours. I recovered the bacillus, cultivated it, and I got stalactites. Dr. Ruffer has seen the slides.

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* See Appendix No. XX in this Volume.

Major Green.

5th Jan. 1899.

8427. What is the date of that ?—The date of his death was October 17th. I have shown the tubes to Dr. Ruffer, in the second case.

8428. The third case ?—The third and fourth cases were Balgovind, who died on November 23rd, and Padarat, who died on November 21st. I examined with Major Evans, and we obtained stalactite growths, and the bacilli had the other characteristics of plague. The stalactite growths I showed to Professor Wright and Dr Ruffer.

8429. Did you inject ?—I did not do anything further.

8430. These are four: have you had any other cases ?—I have under cultivation the last case that occurred in the Mayo Hospital.

8431. That is the fifth case ?—That is the fifth case, of which I have not got any positive results yet.

8432. When did you commence the examination ?—On December 27th, a few hours before death. I sterilised the skin with a glass rod, and with a sterilised pipette drew off material, and inoculated several tubes. From these tubes it appears to be growing pure, but it requires further cultivation.

8433. The examination is not yet finished ?—Not yet complete.

8434. Were these put before you as doubtful cases of plague: was there any suspicion in the diagnosis of these cases, or were there symptoms sufficient to make you quite sure of the symptoms of plague ?—The first case, Jaisree, was a well-known case, and it was diagnosed before Calcutta was declared free. In Beni Chowdri's case I was at the *post-mortem*, and I have never seen a more typical case. The *post-mortem* report is with the Principal of the Medical College.

8435. You saw this case during life ?—No; I saw it after death. I assisted at the *post-mortem*.

8436. And the others ?—Balgovind and Padarat I did not see during life. I obtained the materials from the Medical College. The last case I saw during life, Colonel Hendley also saw him.

8437. And from the symptoms during life were you able to come to a definite conclusion ?—I think they were undoubtedly cases of plague.

8438. You have had no other cases: have you ?—No; not that I am sure of. A body was found dead in a house the other day, but I could find no typical bubo. However, I have taken specimens, and it is under cultivation. It is not a case that I could say was plague.

8439. Where did this case occur: in what part of the town ?—In Cotton Street.

8440. Is that in a neighbourhood where plague cases had previously occurred, or not ?—It is in a neighbourhood where there have been a number of suspected cases—suspicious deaths rather.

8441. (*Dr. Ruffer.*)—Do you lay a great deal of stress upon stalactitic growths in the bacteriological diagnosis of plague ?—Yes. From the simply microscopic appearance it is a little difficult. That has been pointed out, and I cannot dispute it. I made some experiments with about 20 different organisms, and I found none giving the particular stalactites of the same character as the plague ones. In the early stages of anthrax you get a slightly wavy appearance that might be suggestive of it, but after a few days it is quite different.

8442. Have you tried this test with many non-motile organisms ?—No; I have not.

8443. Who informs the Port Medical Officer whether there is plague in the town or not ?—The Health Officer.

8444. Yourself then ?—No; Dr. Cook. I mean he gets my returns, and they go to the Port Health Officer in the ordinary way that other infectious diseases are shown.

8445. Did the Port Medical Officer last week make a note on the bill-of-health that plague was supposed to be present in the town ?—Not that I know of.

8446. What I want to know is, supposing the Port Medical Officer gets a notification that there has been a case of plague in the town does he, *ipso facto*, make a note of it on the bill-of-health or not ?—If he received an official report, he would certainly put it on.

8447. Is he bound to enter a note to that effect on the bill-of-health ?—If it is officially reported to him.

8448. Do you know whether he has done so or not ?—I do not know whether it has been officially reported. These cases are based on my opinion, and my opinion may be doubted.

8449. When are cases of plague reported officially, when there are many ? How long do you wait before you report them officially ?—I wait until I am ordered to do so.

8450. You have had no orders to report them officially ?—Not in the ordinary public channels. I have to report every case that occurs, confidentially.

8451. In order to report cases of plague, do you wait until you are told to report them ?—Yes; before I report them in a public manner. At present Calcutta is not considered an infected area. My opinion may not be taken.

8452. But how do you declare Calcutta infected unless the cases are reported ?—I bring to the notice of the authorities all those cases which in my opinion are plague.

8453. To whom do you report them ?—I report them to the Chairman of the Corporation and to Colonel Hendley.

8454. (*Mr. Hewett.*)—You report them officially ?—Confidentially, but officially.

8455. Does that mean that you do not make a public report ?—I do not make a public report.

8456. What do you mean by a public report: an announcement to the public ?—Yes, so that it may appear in the papers, and in the published statistics.

8457. But, so far as you are concerned, you have reported them to the authorities, whose duty it is, if an announcement is to be made, to make that announcement ?—Yes. Of course in several of these cases there has been a doubt as to whether they were imported or not.

8458. So far as you are concerned you have reported them, and the responsible authorities may have accepted your view, or been doubtful about the cases being plague, but they are the people who are responsible for action, not you ?—I have reported all that I consider to be plague.

8459. (*The President.*)—You have reported all you suspected to be plague, whether you had definite information, or not ?—Where I have had evidence only of fever of 4 or 5 days' duration, I have not reported these cases.

8460. Unless you have had some reasonable grounds, you have not reported them ?—No.

8461. (*Dr. Ruffer.*)—When you were satisfied that you were dealing with plague cases did you report them as plague cases ?—Yes; I have reported them officially, but confidentially.

8462. As plague cases ?—As plague cases, in my opinion.

8463. (*Mr. Hewett.*)—I want to ask you about these plague cases, which took place in Backergunge. In your précis of the evidence you intended to give you included a description of the case of Sita Nath. It gives the doctor's account of the illness from which he suffered. The last words are something to the effect that the doctor would have thought it pneumonia, but for the fact that plague had occurred among one or two other pupils of Dwarka Nath ?—I can give you the name of the practitioner who reported it.

8464. Please tell us who that was ?—It was a Muhammadan doctor, but it was not the doctor who died.

8465. You did not see the case yourself ?—No.

8466. The doctor (Dr. Sanders) who attended the doctor who died after attending Sita Nath, states that the doctor died of pneumonia, not of plague pneumonia ?—I have noted it in my report that Dr. Sanders saw this man, but did not recognize it. I think these cases are very difficult to recognize, unless you have a series of cases. It is very easy to overlook them.

8467. Specimens of the sputum of some of the patients in the Backergunge district were sent down for examination. Do you know in what state they arrived ?—They did not come to me.

8468. (*Prof. Wright.*)—We had a witness before us yesterday, who gave as his opinion that it was extremely important to examine, bacteriologically, all doubtful cases of plague You are deputed to do that: are not you ? Is it part of your duty to examine all doubtful cases of plague ?—It is Major Evans's duty to do all the bacteriological work in connection with plague. I was told that I was to work with him when I was appointed. We were to work together.

8469. He is responsible for the diagnosis ?—Yes, he is responsible for the diagnosis.

Major Green.

5th Jan. 1899.

8470. You take a part also in this, and share the responsibility?—Yes; I work with him. I was told we were to work together, but it was his special work.

8471. The witness, whom I have just referred to, alleged that he had want of confidence in the medical officers to whom the bacteriological diagnosis was committed. He did not allege any special reasons why he had that want of confidence. We want to get at facts: to know what qualifications you have for the duties which have been entrusted to you. Have you worked at bacteriology much?—I have worked at the University College Hospital. Professor Boyce was there then, and I have comparatively recently got the Diploma of Public Health at Cambridge. I was working there, I should think, for nearly six months, off and on. I took it up as a speciality when I was at home on furlough.

8472. How long ago is that?—In April 1895.

8473. You went through a course at the University College?—Yes. Then I was working with Professor Haffkine on cholera inoculation duty for three months.

8474. Were you working in M. Haffkine's laboratory for three months?—Yes. Besides inoculation work, I was doing bacteriological work, and seeing from what cases I could find cholera organisms in the bodies of people who did not die of cholera.

8475. Could you sum up the opportunities you have had for bacteriological work in India? Have you always been at stations where you have had an opportunity of doing bacteriological work?—No; far from it. It is very difficult to do it out of Calcutta.

8476. How many years' service have you had?—Over 12 years.

8477. How many years of that have you had conditions round you such as would allow of your doing bacteriological work?—Well, comparatively rarely: I have been occupied with other things.

8478. I am not finding any fault. I only want to get the facts of the matter. How many years out of these 12 have you been able to do bacteriological work?—I did not take it up until comparatively recently, when I went home last on furlough—in 1895.

8479. Since 1895 have you had opportunities of keeping it up?—I have been off and on doing it ever since.

8480. You said you had worked at University College and at Professor Haffkine's laboratory: where else?—I went to St. Bartholomew's Hospital under Professor Kanthack.

8481. What year was that?—That was also in 1895.

8482. But since you have come to India, what bacteriological opportunities and conveniences have you had?—I have worked in the Health Office laboratory. I have not been continuously, since 1895, in Calcutta. I have been here several times.

8483. How many months of bacteriological work do you think you have had since you have been out here?—About six months.

8484. And how many hours a day have you been able to give to bacteriology during that time?—I average about two hours. I could not say that it would be absolutely every day.

8485. We only want to get at the facts of what your opportunities have been in that matter?—Sometimes it may have been more, but the average is about that.

8486. Have you had opportunities of doing any bacteriological research, or has your work consisted merely in the diagnosis of cases sent to you?—Simply that. Of course I have worked with material in the laboratory. I have not taken up any special line of research beyond that question of cholera organisms which I was working for M. Haffkine.

8487. When working with M. Haffkine, what were you working on—cholera or plague?—Cholera.

8488. Where?—In his laboratory.

8489. What were you doing with M. Haffkine then? Were you growing the cholera for the vaccine?—Yes. I was also attending the *post-mortems* at the Campbell Hospital and the Medical College, and seeing whether I could get cholera organisms from cases that did not die with the symptoms of cholera.

8490. Before you were appointed to make plague diagnosis what experience had you had of plague?—None except in Calcutta as Police Surgeon and Superintendent of the Campbell Hospital. I have been in Calcutta all this summer, was at the Campbell Hospital, and I did a good deal of microscopical work then, although I did not have opportunities of doing bacteriological work.

8491. When you were appointed to make this diagnosis of plague, had you any acquaintance with the micro-organisms of plague? Had you seen any during your course in London in 1895?—No.

8492. Had you seen any in connexion with M. Haffkine's work in Bombay?—No.

8493. Have you seen any plague bacilli before plague cases occurred in Calcutta?—No.

8494. Then how did you recognize in your first cases plague bacilli?—I saw some at the Health Office, which Dr. Cook showed me. That was in April, and I saw also some that Major Evans had at the Medical College.

8495. And that was your equipment when you began to undertake the duties of diagnosis?—That was, when I commenced.

8496. What steps have you taken to differentiate the plague bacillus from the pneumo-coccus? Have you had to diagnose sputum from a suspected plague patient?—Padarat's was a pneumonic case.

8407. Did you diagnose that as plague, by means of the sputum?—No; it was from the *post-mortem*—from a portion of the lung I cut out.

8498. What steps did you take there to differentiate the plague bacillus?—I got the usual growth, with the ground glass appearance when you make a full tube culture, and then I obtained stalactites. I thought that was sufficient.

8499. Did you adopt any special staining methods?—I stained that with carbol-fuchsin; the capsule would probably show out more clearly with pneumo-coccus than it would with the plague bacillus. I do not trust particularly to the microscopical appearance.

8500. You did not apply any other test: did you?—No, beyond the growth and the appearance, and obtaining the stalactite growth. I can give you one of the tubes, if you care to continue the investigation.

8501. Have any cases gone in, reported as plague, on your statement alone, or have you always had them confirmed by Major Evans? Before you reported officially a case to be plague as the outcome of your bacteriological diagnosis, did you get Major Evans to confirm your results?—All the cases I have reported, I have not reported on the bacteriological evidence alone. Unless a case occurs in the hospital, it is very difficult to get a bacteriological examination. Some of them have not been bacteriologically examined. I report them on my own authority. I am not under Major Evans in any way.

8502. I understood that you collaborated with him in making the bacteriological diagnoses. You have reported certain cases on the bacteriological evidence: is not that so?—Yes.

8503. In those cases was the judgment you pronounced purely your own judgment on the bacteriological facts, or did you always call in Major Evans to agree with you on the bacteriological evidence?—I have not submitted them to him formally; as a matter of fact, he has seen them in a friendly way.

8504. You reported in an independent fashion. Somebody is responsible. Were you responsible alone, whether you pronounced them plague on your own opinion, or whether Major Evans saw them?—No, on my own opinion.

(Witness withdrew.)

(Adjourned till Wednesday, January 11th, at Agra.)

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APPENDIX No. II.

JOINT REPORT

ON THE EPIDEMIC OF PLAGUE IN LOWER DAMAUN, PORTUGUESE INDIA, AND ON THE EFFECT OF PREVENTIVE INOCULATION THERE.

BY

Mons. W. M. Haffkine

AND

Surgeon-Major Lyons, I.M.S., *President.*

Government Committee for Investigation of the Bubonic Plague in Bombay.

The plague prophylactic referred to in the present report has been described by Mons. W. M. Haffkine in the "British Medical Journal," May 1897, and in the "Indian Medical Gazette," June 1897.

The facts reported here have been collected by Professors Koch and Gaffky, the heads of the German Scientific Mission to Bombay, and Monsieur Haffkine, on a visit to Damaun on the 20th and 21st May last: at the end of the same month a house-to-house visitation at Damaun was undertaken and carried out, at Monsieur Haffkine's request, by Surgeon-Major Lyons, President of the Bubonic Plague Research Committee, in order to complete, by exact details, the information gathered on the first visit.

At the German Scientists' and Monsieur Haffkine's enquiry at Damaun, their informants were:

His Excellency Col. J. P. **Kuchenbuck Villar**, Governor of Damaun:

Mr. **Judge**, Assistant Collector, Salt Revenue Department, in charge of the Preventive Police and the Plague operations on the Damaun Frontier;

Shet **Sorabjee Manockjee Damaunwalla**, Head of the Parsee community, assisted by his Secretary;

Dr. **Virgilio Poiares**, Physician in charge of the Plague Hospital;

Dr. **Proenca**, Health Officer;

Dr. **Pinto**, in charge of the Plague Operations in Damaun Town; and

Dr. **Da Cunha**, L.R.C.P. (Edinburgh),
Dr. **Moniz**, L.M. & S., and
Dr. **Fernandez**,
} Medical Practitioners of Damaun.

The Medical Officers abovementioned were assembled, on the 20th May 1897, by H. E. the Governor, who was also present, and to whom we are indebted for affording every facility for making the enquiry complete. The general information given below, in the preliminary part of this report, was reported at this meeting and was supplemented by documents from the respective offices.

The history of the Damaun epidemic appears to be as follows:—

The town of Damaun is divided by a river into two parts: Lower Damaun, the largest business part of the town; and the Fort, or Upper Damaun, where the Government house and the Government offices are situated. The plague attacked almost exclusively three of the villages which make part of Lower Damaun, namely, Lower Damaun proper, having, in ordinary times, a population of 5,000 inhabitants; Katheria, the property of Shet Sorabjee Damaunwalla, with a population of 4,700; and Khadiwadi, with a population of 1,200. This part of the town was in active business communication with the Bombay Presidency, and is densely populated, the inhabitants living in small houses crowded together. The Fort was cut off by a cordon from Lower Damaun as soon as the epidemic began to increase in proportion, and had only some ½ dozen imported cases.

The first attacks came to notice in February last, and occurred amongst new arrivals from Bulsar, a neighbouring town which was badly affected at the time, and amongst sailors from Kurrachee arriving at Damaun by sea, in native crafts. Before the end of the same month local cases began to appear among the fishermen, who have their *busti* close to the river, where crafts are moored, behind the Damaun Municipal School. In the last days of the month a hurried exodus of people began from Lower Damaun, increasing daily as the epidemic gained in intensity, until, on the 23rd of March, the Governor placed a cordon along the river, and stopped communication between the Lower and Upper parts of the town; while a week later, on the 30th March, the Bombay Government, on their part, closed British territory to the inhabitants of Damaun. By this time, it was estimated, over 2,000 people had quitted the place.

The worst period of the epidemic corresponded to the month following the closing of the Damaun frontiers. The climax was reached in the middle of April, when the daily number of deaths remained stationary for about 8 days and then began to decline. The largest number of deaths which occurred in one day was 80.

Up to the 25th of April the daily mortality, which was closely watched by the Parsee community who kept peons on the burial and burning grounds, was recorded officially from the information given by the inhabitants coming to the Registration Office to declare cases of deaths in their families. On the 25th April the Governor placed a guard of his own on the burial and burning grounds, and on that day, though the number of deaths reported by the inhabitants was 11, the number of bodies disposed of in the presence of the guard was 34. From the above date the Governor's guard was kept permanently on the grounds, and the official information became complete. The following is the number of bodies registered by this means from the 25th April up to the date of investigation :—

25th April 1897	34	8th May 1897	33
26th ,,	31	9th ,,	18
27th ,,	21	10th ,,	24
28th ,,	49	11th ,,	27
29th ,,	41	12th ,,	15
30th ,,	58	13th ,,	13
		14th ,,	17
1st May 1897	41	15th ,,	13
2nd ,,	22	16th ,,	20
3rd ,,	29	17th ,,	6
4th ,,	47	18th ,,	8
5th ,,	33	19th ,,	13
6th ,,	31		
7th ,,	31	25 days.	675 deaths.

Thus, during the 25 days preceding our visit, *i.e.*, between the 25th April and 19th May 1897, at a time when the population was considerably thinned by desertion and death, and when the mortality had dropped to 8 and 6 a day, the total number of bodies disposed of was 675, giving an average *of 25 deaths a day*. His Excellency the Governor and the medical gentlemen present at the meeting stated that they would be well within the real figure if they estimated the number of deaths which occurred in the fully populated town, in the first period and during the height of the epidemic, *i.e.*, up to the time of placing the guard at an average *of 30 a day*, counting from the 1st March and neglecting the mortality before that date. This estimate gives a total of 2,325 deaths as having occurred in Damaun from the beginning of the epidemic up to the time of the Scientific Committee's visit. Of this number, 2,093 deaths were afterwards authenticated in the particular families where they had taken place, during a house-to-house enquiry instituted by Shet Sorabjee Damaunwalla, the owner of Katheria.[*]

As the immunity of the inoculated in Damaun will be estimated from a comparison with the mortality in the uninoculated population, it is essential, in order to avoid the possibility of exaggerating the power of inoculation, to take for guidance the lowest figure admissible as representing the real death rate in the place. In the following calculations, therefore, the number of deaths from plague which occurred in Damaun from the commencement of the epidemic up to the visit of the Scientific Committee is accepted as 2,093, which is the number authenticated by an enquiry in each of the affected families. This figure gives an average daily mortality from the commencement of the epidemic up to the time of placing guards on the burial and burning grounds, as being close upon 26 deaths a day. From the 21st of May up to the end of the same month, that is to say, up to the date when Surgeon-Major Lyons concluded the additional inquiry, of which the details are given below, there occurred 96 deaths more, giving a total of 2,189 deaths from plague which took place in Damaun during the period under observation.

In this number of deaths there were 24 in those inoculated personally observed by the Medical Officers of the place; *plus* a small number of others of which they knew, but which they had not seen personally. 15 deaths of the 24 were reported by Dr. Moniz, who was said to have treated the largest number of plague patients in the place; 4 by Dr. Poiares, who also saw 4 other cases which recovered; 3 cases by Dr. Proenca, all of whom recovered (these had been seen also by Dr. DaCunha); 3 deaths were known to Dr. DaCunha, and 2 to Dr. Pinto (in addition to one mentioned by Dr. Moniz which Dr. Pinto had seen with him).

Considering the small extent of the town, the limited number of inhabitants, and the number of Medical Officers who were looking after the place, it appeared probable that not many attacks among the inoculated escaped their notice, as such attacks usually excite much comment amongst these inhabitants and attract general attention. Indeed, the gentlemen present at the meeting seemed to know between them every place in the town where inoculated people lived and every house which had suffered from plague or happened to have escaped. As has been mentioned already, they stated at the time that there was a small number of inoculated attacked whom they did not see, but of whom, they informed us, a record existed in the office of Shet Sorabjee Damaunwalla, where, during the plague, a dispensary was opened for distributing gratuitous medicines to the affected population.

It was on the initiative of that Parsee gentleman that the inoculations were introduced. He had a personal knowledge of the people who were inoculated, and kept a watch over the effect of the operation, collecting, with the help of his office establishment, a large number of details in this connection.

From his information it appeared that the total number of deaths amongst the inoculated was under 40, each of the cases being known to him; that amongst those inoculated in a first series of inoculation, done in March last, a smaller proportion got affected and died than amongst those done a month later; and that in a series of inoculations carried out by the Physician in charge of the Damaun Plague Hospital, with lymph supplied from our Bombay Laboratory, the number of attacks was larger than amongst those inoculated by Dr. Kalapesi, Dr. Haffkine's Assistant sent from the Laboratory. These details were found afterwards, in the course of the close investigation carried out by us, to be scrupulously correct.

Mr. Sorabjee had also a guard of his own kept on the burial and burning grounds, watching the course of the mortality, and his information concurred with the statements recorded above. The number of people inoculated up to the time of the Scientific Committee's visit was 1,645; over four times that number remained uninoculated. The latter had lost from plague close upon one-third of their number, and, he considered, there could be no doubt that the inoculated exhibited a most striking degree of immunity.

The effects of inoculation were closely watched by the inhabitants, as will be seen from the following observations which they brought to our notice.

There were altogether 306 Parsees in Lower Damaun, including males, females and children. Of these, 276 were inoculated twice, and one once, all the particulars being given in our inoculation register. The names and particulars of the 29 who remained uninoculated were supplied to us on the spot. The attacks and casualties from plague which occurred in the two groups after the introduction of inoculation are given below.[†] No deaths from any other cause occurred in the community from the beginning of the epidemic.

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[*] The number of deaths from plague which took place during the *whole* epidemic up to the end of July, and a record of which could be obtained by an enquiry in the households, was 2,352 and was distributed amongst the different castes inhabiting Damaun as follows :—

Parsees	6	Tailors	48
Brahmins	26	Ghatis	21
Parbhus	4	Potters	16
Shrawaks	11	Portuguese	34
Banias	23	Bhandarees	22
Lohanas	4	Bhayas	5
Gujrathi Goldsmiths	15	Bhateli	1
Daximi Goldsmiths	80	Dhobis	16
Hindu Barbers	27	Mochis	23
Kahtrais	87	Kolis	19
Coppersmiths	11	Borahs	5
Machis	600	Khojas	4
Carpenters	104	Lohars	13
Mussalmans	440	Mangelas	7
Golas	106	Hindoo Low Castes	351
Chipas	23	Caste unknown	200
		TOTAL	2,352

[†] See also attached Rolls.

App. ii.

Occurrences of Plague amongst the 277 inoculated Parsees.

(1) Jerbai, wife of Manekji Bacha, age 35, belonging to a well-to-do family; was five months pregnant; inoculated once on 17th April 1897, in the right arm. For about 24 hours before she had fever and pain in the groin, but this was not known at the time of inoculation. Developed characteristic plague in the evening of the day of inoculation, had an abortion on 20th morning, died same day.

(2) Seven other Parsees inoculated were attacked, respectively, three days, one week, twelve days, a fortnight, one month, one month and five weeks after inoculation, but all these recovered.

Occurrences of Plague amongst the 29 uninoculated Parsees.

(1) Nanabhai Jivajee, male, age 60, belonging to a well-to-do family, where all the other members (14 in number), except himself, were inoculated. Attacked on 16th April 1897; bubo in left groin; died on 20th.

(2) Merbai, daughter of Byramjee, age 20 years, of a well-to-do family, where eight members were inoculated and four, including Merbai, were not inoculated; attacked about same time as Nanabhai Jivajee; bubo in right groin; died on 20th April.

(3) Ratanbai Ratanjee, female, age 35, of a well-to-do family; attacked and died in the first days of May 1897, having had fever and a bubo.

(4) An old woman, Avabai, widow of Rustomjee, age about 75 years, of a well-to-do family, where fourteen others were inoculated, Avabai and Gulbai, her daughter-in-law, being the only uninoculated. Avabai, got attacked on 11th May, developed bubo two days later, died on the 13th.

Thus in the 29 uninoculated Parsees there were 4 deaths from plague, or a mortality of 13·8 per cent., while in the 277 inoculated there were 8 attacks with only 1 death, the one who died being a woman attacked *before* inoculation, and the mortality thus produced in the inoculated being 0·36 per cent., or 38·3 times lower than in the uninoculated.

Another significant instance, in a limited number of people, was furnished by the servants belonging to Shet Sorabjee's house and to his garden. There are 50 servants in the house where he lives and about 150 in his garden, half a mile distant from the house. Round the garden the epidemic was raging violently. Of the whole number of servants one, a deformed individual, remained uninoculated, all the others were inoculated twice. Plague appeared among the servants on the 16th May, when the only person uninoculated was attacked and succumbed on the 19th; the total number of inoculated lost also one, a child of 4 years.

The other instances given were in isolated families and referred to smaller numbers of people.

The German Commissioners completed this part of the inquiry by collecting information as to the soil of Upper and Lower Damaun, the hydrographic and climatic conditions obtaining in both, their comparative hygienic circumstances, etc. The facts supplied on these points were of an approximate character. The Committee returned to Bombay on the morning of the 22nd May.

Surgeon-Major Lyons went to Lower Damaun on the 26th May 1897, the object of his visit being to find out accurately, by a minute inquiry in each house, the number of deaths which occurred amongst those inoculated. For this purpose he divided the town into 4 sections, and during 4 days between the 26th and 30th May 1897, visited all the houses, section by section. And as a number of dwellings had been vacated and the inhabitants encamped in the fields outside the town, Dr. Lyons visited them in their encampments and collected information from all of them. The frontier around the town being closed and guarded by a British and a Portuguese cordon, the conditions for collecting the necessary information were particularly complete.

In this manner Dr. Lyons collected the history of 33 deaths and 54 attacks with recovery which had occurred in the inoculated up to the 19th May (the time of the Scientific Committee's visit), and of 3 deaths * and 1 attack with recovery which occurred between that date and the 31st of May inclusive.

In the appendix are reproduced 88 "Investigation sheets" filled up by Dr. Lyons during the house-to-house visitation, as well as one sent afterwards by His Excellency the Governor. Each of the investigation sheets contains particulars of a house where inoculated people lived, and where cases of plague had occurred, either among the inoculated or the uninoculated members of the family. These sheets, therefore, do not make mention of the inoculated households where no cases of plague occurred, nor of any of the attacked houses where there were no inoculated persons.

Comparative Analysis of the Mortality from Plague in Lower Damaun, in the inoculated and uninoculated, between the 26th March and the end of May 1897.

The inoculations in Damaun were done in four series:

First Series.—Between the 23rd and 26th March 1897, 846 persons were inoculated by Dr. R. M. Kalapesi, who was sent from the Laboratory, and between the 4th and 7th April, 171 persons by the Portuguese Physician in charge of the Plague Hospital in Damaun, Dr. Virgilio Poiares, who was supplied with material also from the Bombay Laboratory. The lymph used by Drs. Kalapesi and Poiares on that occasion, as will be described later on, was prepared from a strong virus, and produced a high febrile reaction when injected in the prescribed small standard doses. The operations of these two gentlemen differed in that Dr. Poiares gave doses much weaker than those given by Dr. Kalapesi, as is shown by the detailed records of their operations. It will be observed from the results given below, that though Dr. Poiares' patients appear to have given a considerable reduction of mortality when compared with the rest of the population, the results from his small doses were lower than those obtained from the same material given in larger doses.

Second Series.—A few weeks after the first series, the demand for further inoculations coming from Damaun became exceedingly persistent, as was the case, after an interval, in the six other places where inoculations were performed,—in Bombay, Mora, Damaun, Poona, Bulsar and Tarapore; and though the Labo tory had run short of strong material, Dr. Kalapesi was deputed again, with a much weaker lymph than that used on the first occasion, as will be detailed later on. Between the 17th and 27th April, *i.e.*, about a month after his first visit, he performed 529 fresh inoculations, and between the 24th April and 2nd May 1897, 99 more were done by Dr. Poiares with a similar material obtained for him from the Bombay Laboratory by the Bombay Portuguese Consulate. The lymph used on this occasion, even when injected in doses 2 to 3 times larger than the standard ones, failed to produce marked rise of temperature, though it caused considerable local reaction. As will be seen below, both Dr. Kalapesi's and Dr. Poiares' operations, on this occasion, gave a smaller lowering of mortality than those previously performed, though they had both been working with increased doses.

Third Series.—Between the 21st and 23rd of May Dr. Kalapesi inoculated 362 persons with a similarly weak lymph, while Dr. DaCunha, another Portuguese Physician, who had been working in Damaun with Dr. Kalapesi, inoculated 190 persons with the same material.

Fourth Series.—Lastly, in August last, Dr. DaCunha inoculated over 100 persons with material supplied to him from the Bombay Laboratory.

Thus, altogether 2,297 persons were inoculated in Lower Damaun.

The visit of the Scientific Committee coincided with the time of the third series of inoculation, and Dr. Lyons' investigation extended to twelve days later, when the worst part of the epidemic was over, and the daily mortality had come down to below a dozen a day. The present analysis refers, therefore, to the occurrence of attacks and deaths amongst the 2,197 inoculated on the first three occasions, and is divided into three periods of observation, the first corresponding to the interval between the first and second series of inoculations, the second to the interval between the second and third series, and the third to the interval between the third series and the end of the month of May 1897, when the investigation was concluded.

First Period (between the First and Second Series of Inoculations).

At the time when the first series of inoculations was completed, the 26th March 1897, the total number of inhabitants in the affected villages of Damaun, namely, 10,900, had been reduced by 670, who had died of plague before that time, and by about 2,000 who had left the place before the closing of the frontiers.

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* In this number of 3 deaths is included one additional, in the person of Ghopal Bicaria, 9 years, communicated by Dr. Fernandez through H. E. the Governor of Damaun.

Of the 8,230 remaining, 846 were inoculated by Dr. Kalapesi and 171 by Dr. Poiares in their first series of inoculations, while 7,213 remained uninoculated.

From that time up to the time when the second series of inoculations was completed, *i.e.*, the 23rd of April, the following were the occurrences in the respective groups of people:—

(*a*) Amongst the 846 inoculated by Dr. Kalapesi, there were 17 cases with 3 deaths.* (Total mortality, 0·4 per cent; case mortality, *i.e.*, percentage of deaths to attacks, 17·6 per cent.)

(*b*) Amongst the 171 inoculated by Dr. Poiares, there were 6 cases with 3 deaths.* (Total mortality 1·8 per cent; case mortality, 50 per cent.)

(*c*) Amongst the 7,213 uninoculated, there were 716 deaths.† (Total mortality, 9·9 per cent.)

It will be seen that, if the 1,017 inoculated had exhibited the same susceptibility for plague as the uninoculated, and had had the same mortality of 9·9 per cent., the number of deaths amongst them would have been 101 instead of 6, a difference of 94·1 per cent.

Second Period (*between the Second Series of inoculations and the Third Series, or the time of the Scientific Committee's visit*).

By the time when the second series of inoculations was completed, the number of those inoculated by Dr. Kalapesi had decreased by the 3 deaths mentioned above, and increased by 529 newly inoculated, giving a total of 1,372.

The number of those inoculated by Dr. Poiares had decreased by 3 deaths, and increased by 99 newly inoculated, giving a total of 267.

The number of uninoculated had decreased by 716 deaths and by the 628 newly inoculated, leaving a total of 5,869 uninoculated.

From the time of the second series of inoculations up to the time of the Scientific Committee's visit, *viz.*, 19th of May last, the following were the occurrences in the three groups:

(*a*) Amongst the 1,372 inoculated by Dr. Kalapesi there were 52 cases with 18 deaths.* (Total mortality, 1·3 per cent.; case mortality, 34·6 per cent.)

(*b*) Amongst the 267 inoculated by Dr. Poiares, there were 12 cases with 9 deaths.* (Total mortality 3·3 per cent; case mortality, 75 per cent.)

(*c*) Amongst the 5,869 uninoculated, there were 674 deaths. (Total mortality, 11·5 per cent.)

It will be observed that if during the second period of observation, the 1,639 inoculated had had the same mortality as the 5,869 uninoculated, they should have lost 188 instead of 27, which represents a difference of 85·6 per cent.

Third Period (*between the Third Series of inoculations and the end of May, or the time when Surgeon-Major Lyons concluded his investigation*).

At the time of the Scientific Committee's visit to Damaun, the number of those inoculated by Dr. Kalapesi had decreased by 18 deaths, and increased by 552 inoculated by him and Dr. DaCunha, giving a total of 1,906.

The number of inoculated by Dr. Poiares had decreased by 9 deaths, leaving a total of 258 inoculated.

* The number of uninoculated had decreased by 674 deaths and by 552 who got themselves inoculated, leaving 4,643 uninoculated.

During the 12 days which elapsed till Dr. Lyons completed his investigation, these groups produced—

(*a*) The 1,906 inoculated by Dr. Kalapesi, 1 case with 1 death.* (Mortality 0·05 per cent.)

(*b*) The 258 inoculated by Dr. Poiares, 3 cases with 2 deaths.* (Mortality 0·8 per cent.)

(*c*) The 4,643 uninoculated—93 deaths. (Mortality 2 per cent.)

Calculating upon the death-rate amongst the uninoculated, the 2,164 inoculated should have had 43 deaths instead of the 3, which is a difference of 93 per cent.

During the three periods of observation put together, between the 26th March and the end of May, 6,033 uninoculated had 1,482 deaths (24·6 per cent.) while 2,197 inoculated had 36 deaths (1·6 per cent.). Calculating upon the death-rate among the uninoculated we have seen that the inoculated should have had altogether 332 deaths instead of 36. This represents a difference in mortality of 89·2 per cent.

Considering the large proportion in which the number of inoculated stands to the rest of the population (2,197 to 6,033), it is evidently impossible that the inoculated represented the upper, or any other particular, class of the population possessing a degree of personal or local immunity much different from that of the rest of the population, and to which their reduced death-rate could be ascribed.

This view is confirmed by the following comparison of the mortality which occurred in the inoculated and uninoculated persons belonging to the same families, who lived therefore under absolutely identical conditions of life.

In a large number of households the whole of the members of the family were inoculated, leaving none for comparison as regards susceptibility to the disease. This circumstance rendered it necessary to compare the whole inoculated population with the whole of the uninoculated population, as has been done above. However, in 62 of the inoculated families in which cases occurred, there were 124 persons who remained uninoculated, while the number of inoculated in these families was 250 (see attached Rolls). A comparison between this fraction of the inoculated population with their uninoculated relatives shows the following result:

124 uninoculated had 54 cases (43·5 per cent.) with 37 deaths (29·8 per cent., case mortality 68·5 per cent.)

250 inoculated had 50 cases (20 per cent.), with 20 deaths (8 per cent., case mortality 40 per cent.).

The inoculated households lived, therefore, under no specially immune conditions, as the mortality among their uninoculated members, 29·8 per cent., was 5·2 per cent. higher than the mortality in the general uninoculated population. This must invariably be the case, as only people from badly-affected or particularly-threatened localities present themselves for inoculation. It will be noticed also that this small number of 124 uninoculated had a mortality higher by 1 death than the total mortality sustained by the 2,197 inoculated inhabitants of Damaun, and that a comparison between the inoculated and uninoculated members of these families shows that if the 250 inoculated had exhibited the same susceptibility as their 124 uninoculated relatives, they should have had 75 deaths instead of 20, a difference of 73·3 per cent.‡

A similar conclusion is arrived at on comparing the mortality in the Parsee community quoted above, and which shows that the inoculated members gave a reduction of 97·4 per cent. of deaths when compared with the uninoculated of the same community.

It has been mentioned that the lymph used in the first series of inoculations was of an active stock, prepared from a highly virulent microbe, and produced a brisk febrile reaction when used in relatively small doses. Owing to the great pressure of work during the epidemic, no method for keeping up the strength of the plague bacilli has been worked out, and the microbe from which the plague lymph was manufactured was allowed to gradually sink in virulence till it became almost harmless when inoculated into rodents. It was lymph thus weakened that was used in the subsequent inoculations.

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* See attached Rolls.

† As a matter of fact, much more than that, the figure 716 deaths, 9·9 per cent., implying that during the initial three weeks of the epidemic, before the introduction of inoculation and during the first period of 4 weeks after the inoculations, the worst period in the whole epidemic, the mortality was uniformly 26 deaths a day, which of course was not the case.

‡ As far as the small numbers from which the figure 73·3 per cent. is obtained, permit of drawing conclusions, the comparison between this figure and 89·2 per cent. by which the mortality in the *total* inoculated population differed from the mortality in the *total* uninoculated, would seem to indicate that the presence of uninoculated members in a family reduces the safety of the inoculated, and that, like the small-pox vaccination, the duty of the individual is to be inoculated for the safety of his neighbours in the community.

A comparison between the first and second series of inoculations* done with the strong and with the weak vaccines, respectively, shows a difference in result in direct correspondence with the difference in the material used, as will be seen from the following table†:—

1,017 inoculated on the first occasion had 49 cases (4·8 per cent.) with 15 deaths (1·5 per cent., case mortality 30·6 per cent.),

628 inoculated on the second occasion had 41 cases (6·5 per cent.) with 20 deaths (3·2 per cent., case mortality 48·8 per cent.)

The total mortality and the percentage of deaths to cases amongst the inoculated on the second occasion, though they were exposed to the risk of infection during the milder period of the epidemic, was respectively, 2·2 and 1·6 times higher than amongst those inoculated on the first occasion.

Also as mentioned already, Dr. Poiares in his operations used doses considerably lower than those given by Dr. Kalapesi. The difference in the results of these two groups of operations corresponded again to the difference in the method employed, as is seen below:—

Amongst the 1,924 inoculated by Dr. Kalapesi, there were 70 cases (3·6 per cent.) with 22 deaths (1·1 per cent., case mortality 31·4 per cent.,).

Amongst the 270 inoculated by Dr. Poiares, there were 21 cases (7·8 per cent.) with 14 deaths (5·2 per cent., case mortality 66·7 per cent.).

Thus, amongst the inoculated with reduced doses small though their death-rate (5·2 per cent.) was when compared with the death-rate in the uninoculated population (24·6 per cent.), the total mortality was 4·5 times and the case mortality 2·1 times higher than that amongst the inoculated with larger doses.

This variation of the results, answering faithfully to the variation in the strength of the lymph and in the doses given, shows the direct connection of cause and effect in the two series of facts, and makes it probable that it will be in our power to improve upon the results obtained in Damaun.

It also indicates, when the actual figures are examined, that the plague prophylactic has a greater influence upon the number of deaths than upon the number of attacks. This result repeated itself in all the observations collected up to the present on the plague inoculation, and seems to stand in a comprehensible connection with the plan followed in working it out. If this surmise is correct, it will be in our will to effect a further reduction in the number of attacks by correspondingly modifying the composition of the plague prophylactic.

The above satisfactory results were obtained in one of the most virulent outbreaks that have been observed in India in the present epidemic, and during the 9 weeks which corresponded to the highest stage of that outbreak.

The question as to the final duration of the effect of the plague inoculation remains unsolved, but loses its urgent interest in view of the above results.

BOMBAY; (Sd.) W. M. HAFFKINE.
The 1st November 1897. (Sd.) R. W. S. LYONS,
Surgeon-Major, I.M.S.

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* The third series, done shortly before the conclusion of the observations, is left out of this comparison, only one death having occurred amongst those inoculated on the third occasion (see attached Rolls).

† See attached Rolls.

App. ii.

I.

LOWER DAMAUN.

PARTICULARS OF HOUSEHOLDS WHERE INOCULATION HAD BEEN APPLIED AND PLAGUE OCCURRED AFTERWARDS.

Attacks in those inoculated in March 1897, or in their relations.

INVESTIGATED BY SURGEON-MAJOR LYONS, I.M.S.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Katri ward	Laloo Muckla . . . . Male, 25 years . Inoculated in March 1897. Guirdhar . . . . . ,, 4 ,, . ,, ,, Moti Bhicka . . . . Female, 60 ,, . ,, April 1897. Pemi . . . . . Male, 22 ,, . ,, ,, Guirdhar was attacked about 19th April. Had high fever and a cervical gland enlarged. Died after seven days.	
Lower Damaun, Rua Real	Saurrah Lalla . . . . Male, 40 years. . Inoculated in March and April 1897. Argooan . . . . . ,, 7 ,, . ,, ,, ,, Rutton . . . . . Female, 25 ,, . ,, April 1897. Dhauki . . . . . ,, 2 ,, . ,, ,, Argooan was attacked 15 days after inoculation. Had high fever. Died on the second day after the attack.	
Lower Damaun, Braman Falia.	Pershotam Permanand . . Male, 55 years . Inoculated on 23rd April 1897. Harishanker Pershotam . . ,, 23 ,, . ,, 23rd March 1897. Amba Jeevanram . . . Female, 50 ,, . ,, 25th April 1897. Rami Bhapoo . . . . ,, 60 ,, . ,, ,, Jeenah (*vel* Dyah) Ambaram . Male 20 ,, . ,, 23rd March 1897. Manee Ravishanker . . Female, ,, . ,, ,, Harkee Bhapoo . . . ,, 25 ,, . ,, ,, Jeenah (*vel* Dyah) Ambaram was attacked on the 3rd May 1897. Fever at the onset. Temp. 104°. Bubo ran to suppuration. General symptoms extremely mild. Recovered by the 10th May 1897.	Vijlee Atmaram . . . . . . Female, 45 years. Vijlee Atmaram had fever on the 5th April 1897. Buboes in both the groins which ran to suppuration. Symptoms not severe. Recovered by the 23rd April 1897.
Lower Damaun, Braman Falia	Amrootrao Sakharam . . . Male, 45 years . Inoculated in April 1897. Govindrao Amrootrao . . ,, 20 ,, . ,, March 1897. Madhavarao Amrootrao . . ,, 18 ,, . ,, ,, Anandrao Amrootrao . . . ,, 4 ,, . ,, March and April 1897. Ganpatrao . . . . ,, 10 ,, . ,, March 1897. Ganpatrao was attacked a month after inoculation. Bubo in right groin. Had fever, nausea and headache. Recovered.	Rookmani . . . . Female, 35 years. Vamanrao . . . . Male, 3 ,, Chimbai . . . . Female, 8 ,,

Lower Damaun, Kalhiria	Walloh Chenoy	Male,	50 years	Inoculated in March 1897.	Dhanee Canjee	Female, 20 years.
	Canjee	,,	30 ,,	,, ,,	Manneck	,, 2 ,,
	Govan	,,	9 ,,	,, ,,		
	Morar	,,	7 ,,	,, ,,		
	Govan was attacked two and-a-half months after the date of inoculation. Femoral bubo (left). Fever and slight head symptoms. Recovered.					
Lower Damaun	Chabeldas Lucmon	Male,	45 years	Inoculated in March 1897.		
	Jeevy Callan	Female,	35 ,,	,, ,,		
	Annanjee	Male,	18 ,,	,, ,,		
	Ramjee	,,	15 ,,	,, ,,		
	Hargovan	,,	13 ,,	,, ,,		
	Parvati	Female,	10 ,,	,, ,,		
	Ranchore	Male,	8 ,,	,, ,,		
	Laroo Gopal	Female,	13 ,,	,, ,,		
	Bholy	,,	12 ,,	,, ,,		
	Chabeldas Lucmon was attacked a month and-a-half after inoculation. Axillary bubo. High fever and delirium. Died four days after. Parvati attacked one and-a-half month after inoculation. Axillary bubo which suppurated. Fever and headache. Recovered. Laroo Gopal attacked one and-a-half month after inoculation. Femoral bubo and other symptoms of plague. Recovered.					
Lower Damaun, Rua Real	Cooverjee Byramjee	Male,	35 years	Inoculated in March 1897.		
	Dinbai	Female,	30 ,,	,, ,, and April 1897		
	Perozbai	,,	10 ,,	,, ,, ,,		
	Merbai	,,	6 ,,	,, ,, ,,		
	Buribai	,,	50 ,,	,, ,, ,,		
	Dinbai was attacked on the 3rd May. Had fever 106·4°. Severe head symptoms and delirium. Femoral bubo (left) which suppurated and burst. Recovered.					
Lower Damaun, Rua Real	Walab Withal	Male,	43 years	Inoculated in March 1897.		
	Bani	Female,	49 ,,	,, April 1897.		
	Lalloo H.	Male,	36 ,,	,, March 1897.		
	Pemi	Female,	30 ,,	,, ,,		
	Bani	,,	13 ,,	,, ,,		
	Kashi	,,	11 ,,	,, ,,		
	Bichi	Male,	6 ,,	,, ,,		
	Walab Withal was attacked two months after inoculation. Femoral bubo which was cauterized. Fever, nausea and delirium. Recovered. Bani, aged 49, was attacked ten days after inoculation. Had high fever, head and backache. Femoral (right) bubo cauterized. Recovered. Lalloo H. was attacked two months after inoculation. Had very high fever and severe head symptoms. Right femoral bubo. Died on the 15th May Kashi was attacked ten days after inoculation. Had fever and vomiting. Femoral bubo (right) which suppurated. Recovered.					

I.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague—continued.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the date of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Rua Real .	Sorabjee Nowrojee . . . Male, 18 years . Inoculated in March and April 1897. Rustomjee . . . . ,, 13 ,, . ,, ,, ,, Frambai . . . . . Female, 35 ,, . ,, ,, ,, Frambai was attacked 12 days after the second inoculation. Had fever, nausea, headache and backache. Femoral bubo (right). Recovered.	
Lower Damaun, Causerward, Rua de Caldereiros.	Callanjee Dyaljee . . . Male, 35 years . Inoculated in March 1897. Madaorao . . . . ,, 8 ,, . ,, ,, Shakoo . . . . . Female, 4 ,, . ,, ,, Callanjee Dyaljee was attacked a month after inoculation. Had fever, nausea, headache and delirium. Had a boil on the right foot. Recovered.	
Lower Damaun, Rua Real .	Perozbai Rattonjee . . . Female, 30 years . Inoculated in March and April 1897. Syrikbai . . . . . ,, 20 ,, . ,, ,, ,, Virbaijee . . . . . ,, 50 ,, . ,, ,, ,, Nanabhai . . . . . Male, 70 ,, . ,, ,, ,, Janamjee . . . . . ,, 11 ,, . ,, ,, ,, Rustomjee . . . . . ,, 8 ,, . ,, ,, ,, Pirsha . . . . . ,, 4 ,, . ,, ,, ,, Bejanji . . . . . ,, 3 ,, . ,, ,, ,, Bejanji was attacked on the fifth day after the second inoculation. Had fever on the same day. Femoral bubo appeared on the sixth day, suppurated and burst. Recovered.	
Lower Damaun, Rua Real .	Gangadas Banah . . . Male, 45 years . Inoculated in March 1897. Bicu . . . . . ,, 6 ,, . ,, ,, and April 1897. Nano . . . . . ,, 4 ,, . ,, ,, ,, Navi . . . . . Female, 28 ,, . ,, ,, Goolab . . . . . ,, 1 ,, . ,, ,, Bicu was attacked 15 days after second inoculation. Had fever and vomiting. Femoral buboes (both sides). Recovered.	
Lower Damaun, Rua de Carpenteiros.	Narsal Lulla . . . . Male, 42 years . Inoculated in April 1897. Vamally . . . . . ,, 18 ,, . ,, March and April 1897. Ramjee . . . . . ,, 11 ,, . ,, ,, ,, Gomti . . . . . Female, 15 ,, . ,, ,, Ramjee was attacked on the 16th May. Had fever, head and backache; left axillary bubo. Recovered	

Lower Damaun, Rua Real	Nanabhai Rustomjee	Male,	51 years	Inoculated in March and April 1897.	Avambai Rustomjee	Female, 70 years.
	Hirjeeboy	,,	38 ,,	,, ,, ,,		
	Rustomjee N.	,,	24 ,,	,, ,, ,,		
	Pallonjee	,,	14 ,,	,, ,, ,, and May 1897.		
	Cowasjee	,,	13 ,,	,, ,, ,,		
	Pestonjee	,,	10 ,,	,, ,, ,,		
	Nasarvanji H.	,,	12 ,,	,, ,, ,,		
	Jahangir	,,	7 ,,	,, ,, ,,		
	Navalsha	,,	5 ,,	,, ,, ,,		
	Frambai	Female,	50 ,,	,, ,, ,,		
	Perozbai	,,	27 ,,	,, ,, ,,		
	Dhanbai	,,	19 ,,	,, ,, ,,		
	Merbai H.	,,	10 ,,	,, ,, ,,		
	Goolbai H.	,,	30 ,,	,, ,, ,,		
				,, May 1897.		
	Nasarvanji H. was attacked 15 days after inoculation. Had fever, headache and vomiting. Femoral bubo right side. Recovered after seven days.				Avambai Rustomjee was attacked on the 11th May. Had high fever; femoral bubo (right). Died on the 13th May 1897.	
Lower Damaun, Vancavad	Dipehchand Arichand	Male,	42 years	Inoculated in March and April 1897.	Oojambai Nemichand	Female, 55 years
	Virchand	,,	30 ,,	,, ,, ,,		
	Navalchand	,,	15 ,,	,, ,, ,,		
	Chunilal	,,	8 ,,	,, ,, ,,		
	Camlah	Female,	11 ,,	,, ,,		
	Monicore	,,	25 ,,	,, ,,		
	Omedkore	,,	7 ,,	,, ,,		
	Chimanlal	Male,	3 ,,	,, ,,		
	Chunilal was attacked eight days after inoculation. Had fever, headache, nausea and femoral bubo (right). Recovered.				Oojambai Nemichand was attacked about middle of May. High fever, headache, delirium, nausea and vomiting. Right femoral bubo. Recovered.	
Lower Damaun, Rua Real	Sorabjee Mancherjee	Male,	54 years	Inoculated in March and April 1897.	Navajbai Nowrojee	Female, 65 years.
	Sonabai	Female,	47 ,,	,, ,, ,,		
	Jamshetjee	Male,	14 ,,	,, ,, ,, and May 1897.		
	Hormusjee	,,	12 ,,	,, ,,		
	Hormusjee was attacked on 2nd April. Had at the onset bubo in the left groin. Two days after, high fever, temperature 104·2°, head and backache and vomiting. Recovered after nine days.					
Lower Damaun, Rua Real	Bagwan Kushal	Male,	26 years	Inoculated in March and May 1897.	Ruttom Pemahin	Female, 20 years.
	Ambi Baj	Female,	2 ,,	,, ,, ,,		
	Bagwan Kushal was attacked 16 days after the second inoculation. Had high fever, vomiting, head and backache. Femoral bubo right side. Recovered.					

I.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague—continued.

Full Address.	Names, sexes, and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Darjiwad (Wamawad).	Mangal Ooker . . . . Male, 25 years . Inoculated in March 1897 . . Rutton Dulab . . . . Female, 19 ,, . ,, ,, . . Bhicky . . . . . ,, 9 ,, . ,, ,, . . Rutton Dulab was attacked 15 days after inoculation. Femoral and axillary buboes; suppurated. Recovered.	Laroo Kirio . . . . Female, 55 years. Rutton Bagwan . . . . . . ,, 32 ,, Dhankore Vithal . . . . . . ,, 2 ,,
Lower Damaun, Kathiria .	Gungha Bhagwan . . . Female, 40 years . Inoculated in March 1897. Vanmally . . . . Male, 11 ,, . ,, ,, ,, Bhicky . . . . . Female, 14 ,, . ,, ,, ,, Gungha Bhagwan was attacked 11 days after inoculation. Had fever, head and backache, and nausea. Femoral bubo left side. Recovered.	
Lower Damaun, Rua Real House No. 46	Maneckbai Nasvanjee . . . Female, 38 years . Inoculated in March and April 1897. Bicaijee . . . . . . Male, 6 ,, . ,, ,, ,, ,, Maneckbai Nasvanjee was attacked six days after the second inoculation. Had fever, headache, vomiting, and femoral bubo on the right side, which suppurated and healed. Recovered.	
Lower Damaun, Gathiwad .	Navrojee Dhunjeebhoy . . . Male, 45 years . Inoculated in March and April 1897. Kookibai Navrojee . . . Female, 38 ,, . ,, ,, ,, ,, Kekobhai . . . . . Male, 6 ,, . ,, ,, ,, ,, Perosha . . . . . ,, 3 ,, . ,, ,, ,, ,, Kekobai had high fever, headache, vomiting and femoral bubo three days after inoculation. Recovered.	
Lower Damaun, Vadi Falia .	Narayan Withal . . . Male, 28 years . Inoculated in March 1897.	Gungha Narain . . . . Female, 4 years. Daily I. . . . . ,, 25 ,, Daily II. . . . . ,, 17 ,, Daily I. was attacked on 10th April. Had high fever, head and backache, no glands. Died four days later. Daily II. was attacked on the 30th March. Had high fever, headache and delirium. No glands. Died three days later.

Lower Damaun, Braman Falia	Hootamchand Dyah	Male, 22 years	Inoculated in March and April 1897.	Dayehand Panachand . . . . . . Male, 51 years. Parwaty Varodman . . . . . . Female, 48 ,, Parwaty Varodman was attacked on the 15th April and died on the 20th of the same month. Had fever, headache, nausea and vomiting. Bubo in the right groin.
	Rormany	Female, 20 ,,	,, May 1897.	
	Jeechand	Male, 3 ,,	,, ,, ,,	
	Cubly	Female, 5 ,,	,, ,, ,,	
	Kallan Ramji	Male, 48 years	Inoculated in March, April and May 1897.	Rama Keshadjee . . . . . . Male, 70 years. Keser . . . . . . Female, 60 ,, Rama Keshadjee was attacked 15 days after the date of the inoculation of the others. Had fever, headache and delirium. No bubo. Died after three days. Keser was attacked 12 days after inoculation of the others. Had fever and headache. Axillary bubo. Recovered.
	Ambu	Female, 40 ,,	,, ,,	
	Ginah	Male, 18 ,,	,, ,,	
	Ladoo	Female, 50 ,,	,, April 1897.	
	Rami	,, 14 ,,	,, ,, ,,	
	Jagjiwan Wallab	Male, 24 years	Inoculated in March and April 1897.	Anni Dallu . . . . . . Female, 40 years. Parwati . . . . . . ,, 20 ,, Divaly . . . . . . ,, 20 ,, Anni Dallu was attacked 15 days after the date when the others were inoculated. Had high fever, headache, femoral bubo (right). Was taken to the plague hospital and died on the same day. Parwati was attacked on the same day. Had fever, headache, delirium and femoral bubo (left). Was taken to the plague hospital and died the next day.
	Baglah	,, 14 ,,	Inoculated in March, April and May ,, ,, 1897.	
Lower Damaun Rua Real	Eduljee Fakirjee	Male, 21 years	Inoculated in March, April and May 1897.	Nanaboy Jewaji . . . . . . Male, 60 years. Nanaboy Jewaji was attacked on the 16th April. Had very high fever, nausea, vomiting, head and backache. Femoral bubo (right); suppression of urine. Died on the 20th April 1897.
	Ratanbai	Female, 50 ,,	,, ,, ,,	
	Sonabai	,, 27 ,,	,, ,, ,,	
	Bachoobai	,, 26 ,,	,, ,, ,,	
	Virbaijee	,, 18 ,,	,, ,, ,,	
	Duntai	,, 40 ,,	,, ,, ,,	
	Baijee	,, 11 ,,	,, ,, ,,	
	Faramjee	Male, 7 ,,	,, ,, ,,	
	Dinbai	Female, 8 ,,	,, ,, ,,	
	Doshibai	,, 5 ,,	,, ,, ,,	
	Perosha	Male, 3 ,,	,, ,, ,,	
	Morio	,, 12 ,,	,, ,, ,,	
	Divjee	,, 10 ,,	,, ,, ,,	
	Luckmi	Female, 50 ,,	,, ,, ,,	
Lower Damaun, Kathiriwad	Byramjee Nanabhoy	Male, 48 years	Inoculated in March and April 1897.	Merbai B. . . . . . . Female, 20 years. Maneckbai Dinshaw . . . . . . ,, 60 ,, Jamsetjee Dinshaw . . . . . . Male 37 ,, Jeevanbai Dinshaw . . . . . . Female, 33 ,, Merbai B. was attacked about the 18th April. Had high fever, nausea, vomiting, head and backache. Femoral (left) bubo. Died on the 20th April.
	Sorabjee Byramjee	,, 25 ,,	,, ,, ,,	
	Bicai	Female, 40 ,,	,, ,, ,,	
	Jehangir	Male, 16 ,,	,, ,, ,,	
	Ruttonbai B.	Female, 10 ,,	,, ,, ,,	
	Femina	,, 6 ,,	,, ,, ,,	
	Dinshaw	Male, 7 ,,	,, ,, ,,	
	Ruttonshaw	,, 3 ,,	,, ,, ,,	

App. ii

I.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague—continued.

Full Address.	Names, sexes, and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.			Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.	
Lower Damaun, Katheria	Dhanjee Bhickha Mockun Gopy	Male, 30 years " 10 " " 7 "	Inocculated in March 1897. " " " "	Govan Bhickha Mangly	Male, 20 years. Female, 40 "
				Govan Bhickha was attacked on the 10th May. Left axillary bubo. Fever, headache. Died on the 20th May. Mangly was attacked about 11th May. Had fever, head and backache and delirium. Femoral buboes on both sides. Ill at time of investigation.	
Lower Damaun, Parboowad	Jeenah Sadashiv Luckmi Durgha Shewkore Gurgah Sanker Divaly Paly	Male, 55 years " 35 " Female, 30 " " 50 " Male, 18 " Female, 18 " " 3 "	Inoculated in March 1897. " " " " " " " " " " " "	Jaikore Kashiram Manabi	Female, 19 years. " 15 "
				Jaikore Kashiram was attacked 20 days after the date of inoculation in this house. Had fever, headache, delirium and femoral bubo (left). Died after four days. Manabi was attacked on the same day. Had fever, headache, nausea and vomiting. Femoral bubo (left). Died after six days.	
Lower Damaun, Katheria	Junjee Chamario	Male, 40 years	Inoculated in March and April 1897	Margli Sodkar Coowardy Maude	Female, 35 years. Male, 20 " Female, 18 " Male 10 "
				Coowardy was attacked about the 18th May. Had high fever, head and backache, nausea, vomiting, severe diarrhœa and delirium. No bubo. Ill at the time of investigation.	
Lower Damaun, Parboowad	Ranchorjee Aritram Nansi Wishwanath	Male, 48 years " 3 "	Inoculated in March 1897. " "	Wishawanath Aritram	Male, 55 years.
				Wishawanath Aritram was attacked on 28th March. Recovered.	
Lower Damaun, Rua Luiz de Camoëns (Rua de M. S. Vaz.)	Jose Maria St. Anna Chariza	Male, 22 years Female, 13 "	Inoculated in April 1897. " in March and April 1897.	Maria Francisca	Female, 24 years.
				Maria Francisca was attacked on the 14th April. Had high fever, headache, nausea and delirium. Femoral buboes on both sides. Recovered.	

Lower Damaun, Rua Real.

Ruttonjee Cowasjee	Male,	52 years	Inoculated in March, April and May 1897.
Sorabjee	„	30 „	„ „
Faramroj	„	10 „	„ „
Nasvanjee	„	10 „	„ „
Virbai	Female,	44 „	„ „
Doshibai	„	28 „	„ „
Aymai	„	24 „	„ „
Syrinbai R.	„	21 „	„ „
Sakerbai	„	18 „	„ „
Coowerbai	„	13 „	„ „
Banoobai	„	6 „	„ „
Goolbai	„	5 „	„ „
Fenima	„	2½ „	„ „
Syrombai S.	„	10 „	„ „
Dinshaw	Male,	6 „	„ „
Aymai	Female,	5 „	„ „
Peroshaw	Male,	2 „	„ „
Syrinbai B.	Female,	2 „	„ „
Mahomed Cassam	Male,	25 „	Inoculated in March 1897.
Roopabai	Female,	30 „	„ „
Jerbanoo S.	„	4 „	„ „

Mahomed Cassam was attacked a month after inoculation. Had very high fever, head and backache and delirium. Left femoral bubo. Died three days after.

Roopabai was attacked on the 19th April. Had fever, head and backache. Left femoral bubo. Recovered.

Banio	Male,	70 years.
Jinky	Female,	60 „
Bavio	Male,	12 „

Bavio was attacked on the 14th April. Had fever, head and backache, nausea and vomiting. Femoral bubo on left side. Died on the 18th April.

Lower Damaun, Rua Real.

Vithal Jeevan	Male	Inoculated in March 1897.

Vithal Jeevan was attacked on the 17th May. Bubo in the left groin. High fever, nausea and vomiting. Recovered.

Kashi	Female,	22 years.
Bauee	„	75 „

Kashi was attacked about a month after the date of inoculation. Left femoral bubo; high fever. Recovered in about eight days.

Lower Damaun, Parboowad.

Harnee Rungopal	Female	26 years	Inoculated in March 1897.
Dhondee	„	10 „	„ „
Jaideo	Male	3 „	„ „
Sunder	Female,	5 „	„ „
Dinkore	Male,	2 „	„ „
Mardli	„	5 „	„ „

Mardli was attacked 12 days after the date of inoculation. Had fever, headache and femoral bubo (left). Died four days after the attack.

Harnee and Dhondee were attacked eight days after the date of inoculation. Had fever and headache. The first had femoral bubo (right) and the second axillary bubo (right). Both recovered.

Govindro	Male,	36 years.
Babajee	„	50 „
Gaobai	Female,	40 „

Govindro was attacked 15 days after the date of inoculation of others. Had fever, headache and vomiting. Femoral bubo (right). Died.

Babajee was attacked about the same date. Had fever and headache. No bubo. Died five days after the attack.

Gaobai was also attacked about the same date. Had fever, head and backache. Died four days after the attack.

I.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague—concluded.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the date of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Kathriwad .	Pitamber Ragunath . . . Male, 50 years . Inoculated in March 1897. Luckhmi . . . . . Female, 45 " . " " Arkore . . . . . " 10 " . " " Narayan . . . . . Male, 5 " . " " Arkore was attacked 20 days after inoculation. Had right femoral bubo which suppurated and fever. Recovered.	Somlah . . . . Male, 20 years. Manglu . . . . . . " 9 " Somlah and Manglu were attacked about the 25th March. Had fever, head and backache, nausea and vomiting. Somlah had cervical bubo and died after ten days. Manglu had femoral (left) bubo. Died after four days.
Lower Damaun, Braman Falia	Harishanker Purshotam Patack. Male, 40 years. Inoculated on 25th March 1897. Harishanker Purshotam Patack was attacked on the 2nd April. Had high fever, severe head symptoms, nausea and vomiting. Femoral bubo in the left groin. Recovered after six days.	Nankore Devram . . . . Female, 37 years. Narkore Devram was attacked on the 10th April. Had high fever, head and backache, nausea and vomiting. No bubo. Recovered after 15 days.
Lower Damaun, Rua de Macotinho.	Guella Wallob . . . . Male, 20 years . Inoculated on 25th March 1897. Wallob Jeevan . . . . " 23 " . " in April 1897. Dhanee . . . . . Female, 18 " . " " Divaly . . . . . " 11 " . " " Guella Wallob was attacked on the 10th April. Had very high fever. Was semi-conscious and delirious for three days. Bubo in the groin. Recovered.	Bulky Wallob . . . . Female, 35 years. Bulky Wallob was attacked on the 8th May. Had fever, nausea, delirium and submaxillary gland enlarged. Died eight days after.

II.

LOWER DAMAUN.

PARTICULARS OF HOUSEHOLDS WHERE INOCULATION HAD BEEN APPLIED AND PLAGUE OCCURRED AFTERWARDS.

Attacks in those inoculated in April and May 1897, or in their relations.

INVESTIGATED BY SURGEON-MAJOR LYONS, I.M.S.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague.

Full Address.	Names, sexes, and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the me house on date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Rua Quadrada. (Maneckjee Danjeebhoy Street.)	Maneckjee Beekajee . . . Male, 45 years . Inoculated in March and April 1897. Bachoobai Maneckjee . . Female, 16 " . " " " Bicajee Maneckjee . . . Male, 12 " . " " " Najambai . . . . Female, 6 " . " " " Manecbai . . . . " 2 " . " " " Jerbai Maneckjee . . . " 35 " . " " " Jerbai Maneckjee was attacked one dav before inoculation and died three days later.	Sonabai Dorabjee . . . . . Female, 55 years.
Lower Damaun, Rua de Carpenteiros.	Gopal Narain . . . . Male, 32 years . Inoculated in March and April 1897. Cashi Hari . . . . Female, 30 " . " April 1897. Cashi Hari was attacked eight days after inoculation. Had high fever, severe headache, symptoms, nausea and vomiting. Femoral bubo (right). Recovered.	Jamna Lalljee . . . . . Female, 55 years. Jamna Lalljee was attacked six days after the date of inoculation in this house. Femoral bubo (right). High fever, headache, vomiting and delirium. Died six days after the attack.
Lower Damaun, Chanta .	Balkrishna Hiraji . . . Male, 24 years . Inoculated in April 1897. Bicken . . . . . " 17 " . " " Haribao . . . . . " 11 " . " " Pandurang . . . . . " 9 " . " " Atmaram . . . . . " 6 " . " " Maneck . . . . . Female, 13 " . " " Pandurang was attacked three days after inoculation and died on the fourth day. Had bubo in the left groin. Fever, nausea and headache.	Hiraji Callanji . . . . . Male, 42 years. Nanabhai . . . . . . " 25 "
Lower Damaun, Gathiwad .	Pershotam Morby . . . Male, 16 years . Inoculated in April 1897.	Morby Luckmon . . . . . . Male, 50 years. Pemi Nanabhoy . . . . . . " 45 " Jamna Morby . . . . . . " 20 " Morby Luckmon was attacked on the 10th May and died after seven days. Had fever, headache, and pain at the back. No gland enlarged. Jamna Morby was attacked on the 16th May and died on the 20th. Had left axillary gland enlarged. Fever and headache.
Lower Damaun, Rua de Macotinha.	Rani Gopal . . . . . Female, 16 years . Inoculated in April 1897. Divaly . . . . . " 22 " . " " Morar Bhagwan . . . . Male, " . March 1897. Divaly was attacked five days after inoculation. Had femoral gland of the right side enlarged. Fever, headache, nausea and pain in the back. Recovered.	Pemi Cowasjee . . . . . Female, 35 years. Pemi Cowasjee was attacked on the 5th April. Had axillary bubo (left side), fever and headache. Recovered.

II.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague—continued.

Full Address.	Names, sexes, and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated;* date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated;* date of onset of disease, symptoms, issue.
Lower Damaun, Golwad	Ramjee Lalloo . . . . Male, 45 years . Inoculated in April 1897. Ramjee Lalloo was attacked three days after inoculation. Had fever, hœmoptisis and cough. Died.	Cower . . . . . . Female, 35 years. Chunia . . . . . . Male, 3 ” Maneck . . . . . . Female, 55 ”
Lower Damaun, Rua de Macotinha.	Dhulob Bhicu . . . . Male, 25 years . Inoculated in April 1897.	Bhicu Vittoba . . . . . Male, 55 years. Godavrybai . . . . . Female, 35 ” Sonabai Hirajee . . . . . ” 17 ” Manky . . . . . ” 11 ” Godavrybai was attacked about 12th May. Had bubo in the left groin. Very high fever, nausea and vomiting for three days. Recovered. Sonabai Hirajee was attacked about the 15th April. Femoral bubo. High fever, nausea, headache and delirium. Recovered.
Lower Damaun, Rua Real	Gopal Dhulob . . . . Male, 25 years . Inoculated in April 1897. Rutton . . . . . Female, 20 ” . ” ” Nandoo . . . . . ” 6 ” . ” ” Manky . . . . . ” 3 ” . ” ” Daily . . . . . . ” 2 ” . ” ” Gopal Dhulob and Rutton were attacked 13 days after inoculation. Gopal Dhulob had very high fever with severe head symptoms. No bubo. Died four days after. Rutton had high fever. Bubo in the groin. Was taken to the plague hospital and died five days after.	Guirdhar Gopal . . . . . Male, 5 years.
Lower Damaun, Kathiria	Rama Dhulob . . . . Male, 20 years . Inoculated in April 1897. Keshav . . . . . ” 5 ” . ” ” Nutbi . . . . . Female, 35 ” . ” ”	Daji Gonsal . . . . . . Male, 30 years. Daji Gonsal was attacked 12 days after the date of inoculation. Had femoral bubo (right). Fever, headache, delirium and nausea. Died five days after the attack.

Lower Damaun, Rua Viscondi de Olerem (Ghatiwada) .	Bhavani Dagroo . . . . Male, 35 years . Inoculated in April 1897. Shakoo Govind . . . . Female, 25 " . " " Sukey Bawani . . . . " 6 " . " " Gampoo Krishna . . . . Male, 5 " . " "	Dagroo Koosajee . . . . Male, 60 years. Mookty Bairoo . . . . Female, 30 " Dagroo Koosajee was attacked in April 1897. Died after six days. Had axillary bubo. Mookty Bairoo was attacked in April 1897. Died after seven days. No buboes, but other symptoms of plague.
Lower Damaun, Rua Real .	Guirdhar Gopal . . . . Male, 50 years . Inoculated in April 1897. Motia G. . . . . . " 40 " . " " Jugea . . . . . . " 10 " . " " Bhicklu . . . . . . " 8 " . " " Guirdhar Gopal was attacked 15 days after inoculation. Had fever, head and backache. Femoral bubo (right). Died five days later. Motia G. was attacked eight days after inoculation. Had fever and headache, but no bubo. Died three days later. Jugea was attacked ten days after inoculation. Had fever and headache. Femoral bubo (left) which was cauterized. Recovered.	Gungaoh . . . . Female, 30 years.
Lower Damaun, Kathiria .	Wallob Fakir . . . . . Male, 40 years . Inoculated in April and May 1897. Ditia . . . . . . " 15 " . " " " Cower . . . . . . Female, 15 " . " " " Jeevie . . . . . . " 12 " . " " " Canjee . . . . . . Male, 7 " . " " "	Dhanu . . . . Female, 35 years. Dhanu was attacked eight days after the date of inoculation in this house. Had femoral bubo (right). High fever, headache and delirium. Died after 15 days.
Lower Damaun, Rua de Macotinha (Causerwad), House No. 55.	Govan Ranchore . . Male, 30 years . Inoculated on 21st April and 22nd May 1897. Guardhar Govin . . " 5 " . " " 21st "	Jamna Hirajee . . . . Female, 55 years. Jamna Hirajee was attacked on the 29th April 1897. Temperature at the onset 104·6°. Bubo in the left groin. Died on the 4th May 1897.
Lower Damaun, Rua Real .	Hurgovan Dhulob . . . Male, 40 years . Inoculated in April 1897. Hurgovan Dhulob was attacked 15 days after inoculation. Had fever, headache and femoral bubo. Died five days after.	Gungey . . . . Female, 30 years.
Lower Damaun, Kathiria .	Ruttonjee Vittal . . . Male, 25 years . Inoculated on 21st April 1897. Runchore . . . . . " 16 " . " " Jamna . . . . . . Female, 5 " . " " Peni . . . . . . " 11 " . " " Valy . . . . . . " 11 " . " " Govan Chaba . . . . " 50 " . " " Runchore Vittal was attacked on the 1st May, axillary buboes both sides. High fever, head and backache. Recovered.	Callan Rewah . . . . Male, 18 years. Bhicki . . . . Female, 35 " Pemah Chaba . . . . Male, 45 " Callan Rewah was attacked about the 6th May. Had very high fever, delirium, head and backache, nausea and vomiting. No bubo. Recovered seven days after. Pemah Chaba was attacked on the 22nd April. Had high fever, nausea and vomiting, head and backache. No bubo. Died on the 25th April.

App. ii

II.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague—continued.

Full Address.	Names, sexes, and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Rua Real .	Bickla Cullan . . . . . Male, 25 years . Inoculated in April 1897. Daily . . . . . Female, 20 " . " " Gopal . . . . . Male, 4 " . " " Luckmi . . . . . Female, 2 " . " " Bickla Cullan was attacked nine days after inoculation. Had high fever, delirium, head and backache. Right femoral bubo which was cauterized. Recovered ten days after.	Dajee . . . . Male, 19 years.
Lower Damaun, Rua Real .	Chabu Bagwan . . . . . Male, 56 years . Inoculated in April 1897. Vally Wallob . . . . . Female, 22 " . " " Ambi Vanmally . . . . . " 4 " . " " Bhickli . . . . . . " 45 " . " " Chabu Bagwan was attacked 15 days after inoculation. Had fever, head and backache. Femoral bubo (right) which suppurated. Recovered. Bhickli was attacked ten days after inoculation. Had high fever. No bubo. Died three days after.	
Lower Damaun, Braman Falia, House No. 26. (South line.)	Bai Parwati Paishanker . . Female, 29 years . Inoculated on 23rd March 1897. Hoomabai Ramshanker . . " 7 " . " 24th April 1897. Girjashanker Pranshanker . . Male, 3 " . " "	Itchabai Harishanker . . . . Female, 20 years. Itchabai Harishanker was attacked on the 30th April 1897. Bubo in the left axilla. High fever, temperature 105·3° F.; delirious and unconscious for three days. Recovered by the 12th May 1897. At the time of investigation still under treatment for general debility.
Lower Damaun, Kathiria .	Rajab Burh . . . . . Male, 40 years . Inoculated in April 1897. Sookly . . . . . Female, 30 " . " " Dherio . . . . . Male, 7 " . " " Dherio was attacked 15 days after the date of inoculation. Had femoral bubo (left). Fever, head and backache and nausea. Died three days after the attack.	
Lower Damaun, Rua Real (Kathiria).	Ruttonjee Oamally . . . Male, 30 years . Inoculated in March and May 1897. Luckmon . . . . . " 16 " . " " Rami . . . . . Female, 25 " . " April 1897. Parwati . . . . . " 10 " . " " and May 1897. Mulchand . . . . . Male 4 " . " " " Amba . . . . . Female, 25 " . " "	Bhulis Dhulob . . . . Female, 60 years. Bhulis Dhulob was attacked on the 13th May. Femoral bubo which was cauterized. Fever, headache, nausea and vomiting. Recovered.

	Keshao Hiraji . . . . Male, 40 years . Inoculated in April 1897. Morar . . . . . ,, 45 ,, . ,, ,, Bajwan . . . . . ,, 18 ,, . ,, ,, Dalia . . . . . ,, 6 ,, . ,, ,, Bhicky . . . . . ,, 8 ,, . ,, ,, and May 1897. Keshao Hiraji was attacked nine days after inoculation. Had high fever, head and backache, nausea and vomiting. Femoral bubo (right side) suppurated. Recovered. Dalia was attacked 11 days after inoculation. Had fever, headache, nausea and vomiting. Cervical gland enlarged. Recovered.	Amba Jeewan . . . . Female, 16 years.
Lower Damaun, Kathiria .	Sucky Buna . . . . Female, 26 years . Inoculated in April 1897. Lalla . . . . . Male, 6 ,, . ,, ,, Govan . . . . . ,, 10 ,, . ,, ,, Pemah . . . . . ,, 4 ,, . ,, ,, Sucky Buna was attacked 12 days after the inoculation. Had fever, head and backache. Femoral bubo (left). Recovered. Govan was attacked eight days after inoculation. Had high fever and headache. Cervical buboes (left). Died three days after. Pemah was attacked nine days after inoculation. Had fever, headache and axillary bubo. Died three days after.	
Lower Damaun, Kathiria .	Govan Bicary . . . . Male, 38 years . Inoculated in April 1897. Luckmi . . . . . Female, 60 ,, . ,, ,, Daily . . . . . ,, 40 ,, . ,, ,, Chipky . . . . . ,, 8 ,, . ,, ,, Luckmi was attacked 17 days after the date of inoculation. Fever and other symptoms mild. Femoral bubo (right) which was cauterized. Recovered. Daily was attacked 12 days after inoculation. Femoral bubo. High fever, headache, delirium and vomiting. Died three days after the attack.	
Lower Damaun, Kathiria .	Narain Kalibul . . . . Male, 48 years . Inoculated in April 1897. Divly . . . . . Female, 2 ,, . ,, ,, Divly was attacked 16 days after inoculation. Cervical bubo. High fever, vomiting and convulsion. Recovered after 15 days.	Dhanby Sookly . . . . . Female, 26 years. Dhanby Sookly was attacked 20 days after the date of inoculation. Had very high fever, delirium, head and backache. Aborted after six days. Moribund when seen at the time of investigation.
	Gopal Fakir . . . . Male, 40 years . Inoculated in April 1897. Rami . . . . . Female, 35 ,, . ,, ,, Harjeevan . . . . Male, 9 ,, . ,, ,, Naran Bagwan . . . . ,, 12 ,, . ,, ,, Gopal Fakir and Rami were attacked a month after inoculation. Had fever, headache and vomiting. Gopal Fakir had axillary bubo and Rami femoral (left) bubo, both were cauterized. Recovered. Naran Bagwan was attacked 9 days after inoculation. Had fever and headache. Femoral bubo, which was cauterized. Died after 4 days.	

II.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague—concluded.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Rua Real .	Sucky Callan . . . . Female, 50 years . Inoculated in April 1897. Lucmon . . . . . Male, 16 „ . „ „ Sucky was attacked on the 15th May. Femoral bubo (right side). High fever, nausea and vomiting. Recovered.	Sacoo Dajee . . . . Male, 75 years.
Lower Damaun, Rua Real .	Rahim Shamgee . . . Male, 40 years . Inoculated on 18th April 1897. Sonabai . . . . . Female, 30 „ . „ „ Alli . . . . . Male, 14 „ . „ „ Banjia Manglu . . . . „ „ . „ March 1897. Rahim Shamgee was attacked three days after inoculation. Had high fever, head and backache. Femoral bubo (right side), which appeared six days after inoculation. Recovered. Alli was attacked 20 days after inoculation. Slight fever. Other symptoms also mild. Bubo in the left groin. Recovered.	
Lower Damaun, Rua de brica	Lewis de Silva . . . . Male, 45 years . Inoculated on 7th April 1897. Maria Theresa . . . . Female, 33 „ . „ „ Patrocinia . . . . „ 14 „ . „ „ Carolina . . . . . „ 10 „ . „ March and April 1897. Anna . . . . . „ 7 „ . „ „ „ Francis . . . . . Male, 2 „ . „ „ „ Patrocinia was attacked on 14th May. Had femoral bubo (right). High fever, head and backache, and nausea. Recovered.	
Lower Damaun, Rua Real .	Chuba Dallah . . . . Male, 32 years . Inoculated in April 1897. Bhicky Wallab . . . . Female, 30 „ . „ „ Luckmi . . . . . „ 10 „ . „ „ Callam . . . . . Male, 3 „ . „ „ Chuba Dallah was attacked 20 days after inoculation. Had femoral bubo in the left side. Recovered.	

Lower Damaun, Rua Real	Hirajee Bhula	Male, 39 years.	Inoculated on 21st April and May 1897	Bhicky D.	Female, 72 years.
	Nandi	Female, 30 „	„ in April 1897.		
	Awanjee	Male, 62 „	„ on 21st April and May 1897.		
	Marar	„ 8 „	„ „ „		
	Bhicky W.	„ 55 „	„ in April 1897.		
	Bhicky W. was attacked twelve days after inoculation. Had fever, head and backache. Femoral bubo (right). Recovered.				
Lowar Damaun, Marwer	Dheba Gopal Khalpa	Male, 45 years	Inoculated	Shanti, wife of Gopal	Female, 40 years.
				Mangals Gopal	Male, 24 „
				Somo Gopal	„ 20 „
				Ravi Gopal	„ 15 „
				Shami Gopal	„ 4 „
	Died of plague			Withal Gopal	„ 6 months.
Lower Damaun, Forti	Gopal Bhicara	Male, 9 years	Inoculated on 23rd May 1897.	Bhika Lackma	Male, 40 years.
				Ratti Dhajee	Female, 30 „
				Jamna Bhika	„ 4 „
	Gopal Bhicara was attacked on the date of inoculation. Fever gradually increased and was accompanied by nausea, vomiting and severe head symptoms. Bubo. Died four days after the date of inoculation.			Bhika Lackma was attacked on the 26th May. Had very high fever, severe head and backache and nausea. Right femoral bubo. Died seven days after the attack.	

III.

LOWER DAMAUN.

PARTICULARS OF HOUSEHOLDS WHERE INOCULATION HAD BEEN APPLIED AND PLAGUE OCCURRED AFTERWARDS.

Attacks in those inoculated with reduced doses of prophylactic; or in their Relatives.

INVESTIGATED BY SURGEON-MAJOR LYONS, I.M.S.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague.

Full Address.	Names, sexes, and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Lane opposite Fish Market.	Maria Angelica dos Remedios . Female, 10 years . Inoculated on 5th April 1897. Maria Angelica was attacked 10 days after inoculation. Had high fever, headache and delirium. Right axillary bubo. Died three days after.	Jutto dos Remedios . . . . . Male, 30 years. Alchina . . . . Female, 26 „ Caudinha . . . . „ 5 „ Jono . . . . Male, 1 „
Lower Damaun, Parboowad.	Mackan Jeevan . . . . Male, 55 years . Inoculated on 6th April 1897. Withal . . . . . „ 9 „ . „ „ Withal was attacked 15 days after inoculation. Had axillary and cervical buboes. High fever. Died five days after.	Harki Jeevan . . . . . . Female, 15 years. Pemly Jeeyan . . . . . . „ 35 „
Lower Damaun, Rua dos Carniceiros.	Candenho Lopes . . . Male, 20 years . Inoculated on 25th April 1897. Daniel Pestana . . . . „ 13 „ . „ „	Raza Maria Lopes . . . . . Female, 22 years. Jesmina Lopes . . . . . . „ 40 „ Justiniano . . . . . . Male 6 „ Monte . . . . „ 5 „ Jesmina Lopes was attacked on the 18th May. Had high fever, head and backache, nausea and vomiting, and delirium. Axillary bubo (right). Died on the 24th May.
Lower Damaun, Rua do Carpenteiros.	Narayan Bagwan . . . Male, 40 years . Inoculated on 7th April 1897. Kassan Narayan . . . „ 25 „ . „ 6th „ Ambah . . . . . „ 7th „ Narayan Bagwan was attacked 15 days after inoculation. Had fever and delirium. No bubo. Died five days after the attack.	
Lower Damaun, Rua de Macotinhar.	Bhicka Mackan . . . Male, 24 years . Inoculated on 6th April 1897. Bhicka Mackan was attacked 15 days after inoculation. Had fever, headache and vomiting. Bubo in the left groin. Recovered.	Mackan Lalla . . . . . . Male, 69 years. Luxmi . . . . Female, 2 „
Lower Damaun, Rue dos Carpenteiros.	Dyab Genah . . . . Male, 18 years . Inoculated on 5th May 1897. Ranchore B. . . . . „ 40 „ . „ March „ Rami . . . . . „ 15 „ . „ „ Dyab Genah was attacked on the 6th May. Had high fever (temperature 107°), severe head symptoms. Femoral bubo (left). Died on the 11th May 1897.	

Lower Damaun, Forte de S. Jeronimo.	Rev. Fr. Punenta	Male,	47 years	Inoculated on 6th April 1897.	
	Bicuria Incharia	„	60 „	„ 5th „ „	
	Bicuria Incharia was attacked 20 days after inoculation. Had fever, head and backache. Died on the 6th May.				
Lower Damaun, Rua Maneckjee Sorabjee.	Jeewan Penah	Male,	50 years	Inoculated on 25th March and 8th April 1897.	
	Bhiky Pershotam	Female,	29 „	„ 6th April 1897.	
	Cassam Jeevan	Male,	18 „	„ 25th March and 2nd April 1897.	
	Pali Bhicka	Female,	4 „	„ 6th April 1897.	
	Cashi Jeewan	„	9 „	„ „ „	
	Collan Jeevan	Male,	7 „	„ 25th March and 2nd April 1897.	
	Bhiky Pershotam was attacked on the 25th April. Fever (temp. 103°) and slight headache. Had buboes in the right groin and two about the right side of the right mammary gland. Recovered completely on the 7th May 1897. Pali Bhika was also attacked on the 25th April. Fever temp. 104°. Bubo in the right groin with other symptoms which were mild. Recovered completely on the 5th May 1897.				
Lower Damaun, Rua de Caldereiros.	Withal Hary	Male,	60 years	Inoculated on 5th April 1897.	
	Daya Naran	Female,	45 „	„ „ „	
	Withal Hary was attacked on the 29th April. Fever, headache and delirium. Bubo inguinal and axillary. Died three days after.				
Lower Damaun, Rua Angelica Fish Market.	Camillo do Remedios	Male,	37 years	Inoculated on 23rd April 1897.	
	Humiliano	Female,	27 „	„ „ „	
	Francis	Male,	10 „	„ „ „	
	Ludovina	Female,	7 „	„ „ „	
	Maria Eugenia	„	5 „	„ „ „	
	Vithal	Male,	1½ „	„ „ „	
	Bicaida	„	15 „	„ „ „	
	Francis was attacked on 5th May. Had fever, convulsion and femoral bubo (right). Died three days after the attack.				
Lower Damaun, Rua dos Carniceiros.	Bibiana Falleiro	Female,	43 years	Inoculated on 25th April 1897.	Albin. C. Falleiro.
	Theodoro	Male,	25 „	„ „ „	
	Helena	Female,	30 „	„ „ „	
	Ermelinda	„	18 „	„ „ „	
	Eliza	„	10 „	„ „ „	
	Athala	„	4 „	„ „ „	
	Maria Augusta	„	8 „	„ „ „	
	Francis	Male,	2 „	„ „ „	
	Helena was attacked on the 12th May. Had high fever, nausea and vomiting, head and backache. Femoral bubo on the right side. Died on the 15th May 1897.				

III.

Occurrences of Plague in Houses inhabited by Persons inoculated against the Plague—concluded.

Full Address.	Names, sexes, and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of onset of disease, symptoms, issue.
Lower Damaun, Rua de Caldereiros.	Leopoldina Fernandes . . Female, 45 years . Inoculated on 6th April 1897. Agostinho . . . . Male, 24 " . " " " Joaquim . . . . . " 30 " . " 25th " " Nicolas . . . . . " 1¼ " . " 2nd May " Leopoldina Fernandes was attacked 15 days after inoculation. Had fever, nausea and delirium. Bubo in the right groin, suppurated. Recovered. Nicolas was attacked 29 days after inoculation. Had slight fever and nausea. Bubo in the left groin. Recovered.	Valentino Fernandes . . . . Male, 66 years. Estaphania . . . . Female, 20 " Valentino Fernandes was attacked on 12th April. Had all the symptoms of plague. Bubo left groin. Died on 23rd April 1897. Estaphania was attacked on 5th April. Had fever and headache. Aborted on the 18th April. Bubo in the left groin which suppurated and healed. Recovered.
Lower Damaun, Brahman Falia.	Baichand Virchand . . . Male, 30 years . Inoculated on 2nd May 1897. Melabchand . . . " 22 " . " " " Dyakore Chunibai . . Female, 20 " . " March 1897. Mahanlal Bhaichand . . . Male, 2 " . " " " Baichand Virchand was attacked on the day of inoculation and died three days after. Had fever and enlarged glands in the cervical region and in the groin of left side.	Virchand Nemchand . . . . Male, 60 years.
Lower Damaun, Kathiria .	Bena Narron . . . . Female, 13 years . Inoculated on 28th April 1897. Bena Narron died of plague at the end of May 1897.	Debro Dhohirijan . . . . 12 years. Motis Radis . . . . 35 " Narron Debro . . . . 50 " Bajrodi Narron Debro . . . . 45 " Kali Narron Debro . . . . 22 " Moti Kolakhmis . . . . 35 "
Lower Damaun, Rua dos Caldereiros.	Diamantina Fernandes . . Female, 60 years . Inoculated on 5th April 1897. Dayana M. " . . " 18 " . " " " Theodorico . . . Male, 25 " . " " " Diamantina Fernandes was attacked on the 20th May. Had fever, headache and nausea. Femoral (right) gland enlarged. Recovered.	Anicito do Rozario . . . . Male, 30 years. Maria Luiza . . . . Female, 28 " Antonio . . . . Male, 5 " Aniceto do Rozario was attacked on the 30th April. Had high fever, head and backache. Femoral (left) bubo. Died on the 1st May. Maria Luiza was attacked about the 15th April. Fever, headache and

Lower Damaun, Rua dos Carpenteiros.	Naran Pemah	Male, 18 years	Inoculated on 5th April 1897.	Jamna Maly	Female, 50 years. „ 16 „
	Naran Pemah was attacked on the 16th May. Had very high fever, nausea and severe head symptoms with delirium. Femoral bubo left side. Died on the 23rd May 1897.			Jamna was attacked about a month after the date of inoculation in this house. Had fever, but no bubo. Died five days after the attack.	
Lower Damaun, Rua Real	Jose St. Anna Balbina Sta Anna Verissuno Nicolao Jose Carimo	Male, 33 years Female, 35 „ Male, 9 „ „ 6 „ „ 3 „	Inoculated on 5th April 1897. „ on 2nd May „ „ in March „ „ on 2nd May „ „ in April „	Annanha Fernandes	Female, 25 years.
	Jose St. Anna was attacked about the 15th April. Had high fever, head and backache. Femoral bubo, which was cauterized. Recovered.			Annanha Fernandes was attacked on the 26th March. Had very high fever, delirium, head and backache. Aborted on the 30th March and died on the 1st April.	
Lower Damaun, Near Market	Eufrazia do Rozario	Female, 14 years	Inoculated on 25th April 1897.	Alexendrina do Rozario Adelina Pereira	Female, 45 years. „ 30 „
	Eufrazia do Rozario was attacked five days after the date of inoculation. Had high fever with severe head symptoms. Femoral bubo (right). Died on the 3rd May.			Alexendrina do Rozario was attacked on the 15th April. Had very high fever, nausea, vomiting and severe head symptoms. Cervical bubos on left side. Died on the 26th April. Adelina Pereira was attacked on the 23rd April. Had high fever and head and backache; delirium. Was in an unconscious state for eight days. Femoral bubo (right). Died on the 8th May.	
Lower Damaun, Rua Real	Bagwan Naran Amba Suckuri Mithi Deobai Maneck Persotam	Male, 33 years Female, 33 „ „ 6 „ „ 6 „ „ 3 „ „ 8 „ Male, 9 „	Inoculated in March and on 5th April 1897. „ 5th April 1897. „ in March and May 1897. „ „ „ „ in April and May 1897. „ on 6th April 1897. „ in March and May 1897.	Jamna	Female, 15 years.
	Maneck was attacked about a month after inoculation. Had very high fever with axillary and femoral buboes, which were cauterized. Died on the 19th May 1897.			Jamna was attacked about the 24th April. Had fever, nausea and vomiting. Femoral bubo (left). Died on the 1st May 1897.	

IV.

LOWER DAMAUN.

PARTICULARS OF HOUSEHOLDS WHERE INOCULATIONS HAD BEEN APPLIED AND PLAGUE OCCURRED AFTERWARDS.

Reported attacks in Inoculated which took place after conclusion of Investigation and have not been included in the Analysis.

Full Address.	Names, sexes, and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated* ; date of onset of disease, symptoms, issue.				Names, sexes, and ages of the *uninoculated* persons who were living n the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated* ; date of onset of disease, symptoms, issue.
Lower Damaun. Moda (Rua de Faquir Cassom).	Caetano Machado	Male,	40 years	Inoculated on 25th April 1897.	
	Eugenia Machado	Female,	13 „	„ „	
	Joao Baptista	Male,	15 „	„ „	
	Theodomiro	„	10 „	„ „	
	Narcizo	„	10 „	„ „	
	Verediana	Female,	8 „	„ 28th „	
	Sophia	„	35 „	„ „	
	Jayme	Male,	8 months.	„ „	
	Francisco	„	8 „	„ „	
	Flaviana	Female,	55 years	„ „	
	Maria Francisca	„	28 „	„ 25th „	
	Vicente	Male,	37 „	„ „	
	Agestinho	„	4 „	„ 1st May 1897.	
	Eugenia Machado was attacked on the 30th May. Had high fever, nausea, vomiting and severe head symptoms. No bubo. Died on the 1st June 1897.				

APPENDIX No. III.

REPORT

BY

MONS. W. M. HAFFKINE

REGARDING THE EXPERIMENT ON THE EFFECT OF PROTECTIVE INOCULATION IN THE EPIDEMIC OF PLAGUE AT UNDHERA, TALUKA BARODA, FEBRUARY AND MARCH 1898.

The inoculations were performed in Undhera on the 12th February 1898, with the object of demonstrating to the Baroda authorities the protective effect of the measure. On the above date the population of the village, exclusive of the adjacent suburb, consisted of 950 souls, of whom 47 had been inoculated previously, between the 26th January and the 2nd February 1898, by Dr. C. D. Divanjee, of the Baroda Medical Establishment, and were not inoculated again. All the others, for the purpose of inoculation, were collected in the streets and grouped according to the wards where they resided, family by family. In each household, as nearly as was possible, half the number of the male members, half the number of the females, and half the number of the children were inoculated. The total number of persons thus inoculated was 466, giving, with the 47 inoculated previously, a total of 513, while 437 remained uninoculated. These operations were carried out by Mons. W. M. Haffkine and Surgeon Major Bannerman, Deputy Sanitary Commissioner of Madras, in the presence of M. Rao Bahadur V. M. Samarth, Suba of Baroda Prant, Rao Bahadur Nilkantrao K. Ambegavkar, District Plague Officer, and Dr. K. V. Dhurandhar, L. M. & S., Sanitary Commissioner and Secretary, Plague Arrangements, Baroda State, and with the assistance of the following physicians of the Baroda Medical Establishment:—Drs. Dhanjibhai H. Mehta, L. M. & S.; Chaganprasad D. Divanjee, L. M. & S.; District Plague Duty Medical Officer, Sevaklal M. Dave, L. M. & S.; Gopinath C. Chitnis, L. M. & S.; Gungadhar B. Paranjpe, L. M. & S.; and Surajlal M. Dolatjara, L. M. & S.

The investigation as to the result of the measure was made on the 4th April 1898 by Surgeon Major-General R. Harvey, Acting Director-General, Indian Medical Service, Mons. W. M. Haffkine, Surgeon Major Bannerman, M. Rao Bahadur V. M. Samarth, Rao Bahadur Nilkantrao, K. Ambegavkar, Rao Saheb Ramlal H. Desai, B.A., LL. B., Vahivatdar of Baroda Taluka, and Dr. Chaganprasad D. Divanjee, L. M. & S. All the results were compared with and confirmed by the official documents kept during the course of the epidemic.

The following was the result of the investigation. The plague continued in Undhera up to 26th March 1898, *i.e.*, for 42 days after the inoculations, and affected 28 families. The mortality among the inoculated and uninoculated members was as follows:—

A—AMONG THE UNINOCULATED MEMBERS.

(*a*) One child, of 1 year, named Chitiyo, belonging to the house 68, Ward 1, died of bronchitis, on the 21st February 1898.

(*b*) Three uninoculated died of plague during the first three days after the 12th February 1898, and were not taken into account as having been attacked before the others were inoculated. These persons were:—Bai Bhagirathi, female, 20, of the house 14, Ward 2; Suri *alias* Chanchi, female, 4 years, of the house 15, Ward 3; and Gurtood Jeeva, male, of the house 67, Ward 1.

(*c*) Lastly, from the 15th February 1898 until the end of the epidemic, 27 more attacks of plague occurred amongst the uninoculated, of which 26 died.

B—AMONG THE INOCULATED MEMBERS:

(*a*) There were no deaths from other causes than plague.

(*b*) There were no deaths during the first three days after inoculation.

(*c*) All together, up to the end of the epidemic, there were 8 attacks of plague in the inoculated, of which 3 were fatal. In one of these 3, there was no interval between the inoculation fever and the time when the bubonic fever set in; in the second there was an interval of six days, and in the third of eight days.

Annexed to this report are 28 sheets giving in detail the composition of each affected family and the occurrences of plague among them. The details are summarised in the following table:—

WARD No.	HOUSE No.	UNINOCULATED MEMBERS OF THE FAMILY.			INOCULATED MEMBERS OF THE FAMILY.		
		Total uninoculated in the Family.	Number of Attacks among them.	Number of Fatal Attacks.	Total inoculated in the same Family.	Number of Attacks among them.	Number of Fatal Attacks.
1	8	1	1	1	4	...	...
,,	63	2	1	1	3	...	...
,,	67	2	1	1	3	...	...
2	24	1	1	1	1	...	...
3	1	2	1	1	2	...	...
,,	15	3	...	...	2	1	...
,,	20	4	1	1	3	1	...
,,	29	2	1	1	3	...	...
,,	39	3	1	1	4	1	1
,,	42	2	1	...	1	...	...
,,	48	3	1	1	5	...	...
,,	49	5	1	1	1	...	...
4	7	1	1	1	1	1	...
,,	8	1	...	...	2	1	...
,,	10	1	...	...	4	1	...
,,	12	2	1	1	2	...	...
,,	13	1	1	1	2	...	...
,,	18	2	2	2	3	...	...
,,	26	2	2	2	1	...	...
,,	30	3	1	1	1	...	...
,,	31	2	...	...	4	1	1
,,	34	3	1	1	2	...	...
,,	35	1	1	1	1	1	1
,,	53	2	1	1	2	...	...
,,	80	4	1	1	4	...	...
,,	84	5	2	2	5	...	...
,,	89	1	1	1	2	...	...
,,	90	3	1	1	3	...	...
	Total .	64	27	26	71	8	3

The 64 uninoculated members of the affected families had therefore 27 attacks, of which 26 were fatal. The 71 inoculated had 8 attacks, of which 3 were fatal.

If the inoculated had suffered to the same extent as their uninoculated relatives, they would have had, proportionately to their number, 29 deaths from plague. The actual number appeared reduced by 26, which is a reduction of 89·6 per cent. of mortality attributable to inoculation.

The result as here obtained tallies with all the observations made up to now upon the protective effect of the plague prophylactic, the reduction of mortality effected by it in a plague-stricken population averaging, with a remarkable regularity, between 80 and 90 per cent.*

Further details upon the operations carried out in the Baroda Territory will be reported later on.

Copies of this report are forwarded to—

The Secretary to the Government of India in the Home Department.

The Private Secretary to His Excellency the Governor of Bombay.

The Chief Secretary to the Government of Madras.

The Director-General, Indian Medical Service.

The Surgeon-General with the Government of Bombay.

His Excellency the Divan of Baroda.

W. M. HAFFKINE.

THE PLAGUE RESEARCH LABORATORY,
BOMBAY, *10th April 1898.*

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* Analysing the occurrences of plague in the 28 families according to the sexes of the patients, it appears that amongst the uninoculated there were 24 males, of whom 7 were fatally attacked. Amongst the inoculated there were 41 males, of whom 3 were attacked fatally. This represents a reduction of mortality in males by 75 per cent.

Amongst the uninoculated there were 40 females, of whom 19 were fatally attacked. Amongst the inoculated there were 30 females, of whom none was attacked fatally, though proportionately they should have had 14 deaths. This represents a reduction of mortality in females by 100 per cent.

Analysing the occurrences according to the ages, it appears that amongst the uninoculated there were 16 children under 10 who had 5 deaths and 4 people above 50 who had 2 deaths. Amongst the inoculated there were 19 children under 10 who had 1 death and 4 people above 50 who had no death. This represents a reduction of mortality amongst inoculated children by 83·3 per cent., and amongst people above 50 by 100 per cent.

Amongst the uninoculated there were 44 people between the age of 10 and 50 who had 19 deaths, and amongst the inoculated 48 people of the same age who had 2 deaths. This represents a reduction of mortality in middle-aged people by 90·5 per cent.

Occurrences of Plague in Undhera Village, Baroda Taluka, from the 15th February to the 26th March 1898.

Full Address.	Census Nos., names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of attack or death.	Census Nos., names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of attack or death.
Ward No. 1 House No. 8	25, Dada Shambhu . Male, 50 years . Inoculated on 12th February 1898. 26, Harkha Dada . „ 18 „ . „ on 1st „ 27, Hira . Female, 18 „ . „ on 12th „ 29, Maku . „ 1 month . „ on 12th „	28, Bai Lakhi . . . . . Female, 40 years. 28, Bai Lakhi died of plague on 24th February 1898.
Ward No. 1 House No. 63	269, Kola Kali . Male, 35 years . Inoculated on 12th February 1898. 272, Bapudiya . „ 13 „ . „ „ 273, Gangadi . Female, 2 „ . „ „	270, Bai Jivali . . . . . Female, 30 years. 271, Shankario . . . . . Male, 16 „ 270, Bai Jivali died of plague on 19th February 1898.
Ward No. 1 House No. 67	287, Laloo . Male, 4 years . Inoculated on 12th February 1898. 288, Fuli . Female, 2 „ . „ „ 290, Adali . „ 28 „ . „ „	286, Kashi . . . . . . Female, 26 years. 291, Dahili . . . . . . „ 7 „ 286, Kashi died of plague on 20th February 1898.
Ward No. 2 House No. 24	413, Nanji Kashi . Male, 15 years . Inoculated on 12th February 1898.	414, Galal . . . . . . Female, 50 years. 414, Galal died of plague on 22nd February 1898
Ward No. 3 House No. 1	426, Kalyan Ranchod . Male, 30 years . Inoculated on 29th January and 12th February 1898. 428, Lala . Female, 50 „ Inoculated on 12th February 1898.	427, Jamna . . . . . . Female, 30 years. 428 (A), Fuli . . . . . . „ 6 „ 428 (A), Fuli died of plague on 20th February 1898.
Ward No. 3 House No. 15	475, Shanker . Male, 80 years . Inoculated on 12th February 1898. 477, Jatha . „ 60 „ . „ „ 475, Shanker attacked with plague. There was no interval between inoculation fever and the bubonic fever. Bubo appeared on 23rd February 1898, cured on 3rd April 1898.	473, Shiva Ishver . . . . . Male, 32 years. 474, Bai Ganga . . . . . Female, 28 „ 478, Deali . . . . . . „ 3 months.
Ward No. 3 House No. 20	498, Kashi Trikam . Male, 32 years . Inoculated on 12th February 1898. 499, Fula Kashi . „ 9 „ . „ „ 500, Hira Kashi . Female, 2 „ . „ „ 499, Fula Kashi attacked with plague on 23rd February 1898. Convalescent. There was an interval of 8 days between the inoculation fever and the bubonic fever.	497, Trikam Dwarka . . . . . Male, 55 years. 501, Hari . . . . . . Female, 50 „ 502, Lala . . . . . . „ 28 „ 503, Dahi . . . . . . „ 15 „ 503, Dahi died of plague on 5th March 1898.

Occurrences of Plague in Undhera Village, Baroda Taluka, from the 15th February to the 26th March 1898—contd.

Full Address.	Census Nos., names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of attack or death.				Census Nos., names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of attack or death.		
Ward No. 3 House No. 29	540, Dula Raiji	Male,	20 years	Inoculated on 27th January and 12th February 1898.	541, Bhima Raiji	Male,	20 years.
	543, Mahilo	,,	5 ,,	Inoculated on 27th January and 12th February 1898.	542, Vagie	Female,	22 ,,
	544, Hethi	Female,	3 ,,	Inoculated on 27th January and 12th February 1898.			
					542, Vagie died of plague on 16th March 1898.		
Ward No. 3 House No. 39	586, Prag Govind	Male,	40 years	Inoculated on 26th January 1898	589, Suraj	Female,	5 years.
	587, Darubhai Prag	,,	15 ,,	,, on 29th ,, ,,	591, Kashi	Male,	1 year.
	588, Shivali	Female,	10 ,,	,, on 12th February ,,	592, Raikor	Female,	35 years.
	590, Tribhovan Prag	Male,	4 ,,	,, ,, ,, ,,			
	590, Tribhovan Prag died of plague on 24th February 1898. There was an interval of 8 days between the inoculation fever and the bubonic fever.				589, Suraj died of plague on 3rd March 1898.		
Ward No. 3 House No. 42	603, Mahakor	Female,	40 years	Inoculated on 12th February 1898	601, Bhula Keshar	Male,	26 years.
					602, Kasan	Female,	22 ,,
					602, Kasan attacked with plague on 23rd February 1898. Convalescent.		
Ward No. 3 House No. 48	635, Bhula Kalidas	Male,	35 ,,	Inoculated on 29th January and 12th February 1898.	636, Jamna	Female,	25 years.
	637, Lalloo	,,	18 ,,	Inoculated on 12th February 1898	637, (A), Divali	,,	17 ,,
	638, Madhav	,,	20 ,,	Inoculated on 1st February and 12th February 1898.	640, Ishwar	Male,	4 ,,
	639, Moti Bhula	,,	8 ,,	Inoculated on 12th February 1898			
	641, Lakha Bhula	,,	1 year	,, ,, ,,			
					637 (A), Divali died of plague on 26th March 1898.		
Ward No. 3 House No. 49	645, Gangda Ranchod	,,	20 years	Inoculated on 2nd February 1898	643, Parshotam Rughnath	Male,	40 years.
					644, Tribhovan Ranchod	,,	25 ,,
					646, Jamnadas Ranchod	,,	20 ,,
					647, Daya	Female	50 ,,
					648, Jamna	,,	25 ,,
	......				643, Parshotum Rughnath died of plague on 26th February 1898.		
Ward No. 4 House No. 7	664, Suraj	Female,	35 ,,	,, on 12th ,,	665, Amba	Female,	11 years.
	664, Suraj attacked with plague on 26th February 1898. Convalescent. There was an interval of 11 days between the inoculation fever and the bubonic fever.				665, Amba died of plague on 17th February 1898.		

Ward No. 4 House No. 8	666, Shiva Bhagwan	Male,	25 years	Inoculated on 12th February 1898	667, Dev	Female,	45 years.
	668, Mahakor	Female,	12 „	„ „			
	668, Mahakor attacked with plague on 23rd February 1898. Convalescent. There was an interval of 8 days between the inoculation fever and bubonic fever.						
Ward No. 4 House No. 10	672, Raiji Govind	Male,	28 years	Inoculated on 29th January and 12th February 1898.	671, Ram Govind	Male,	30 „
	273, Shankar	„	26 „	Inoculated on 12th February 1898			
	674, Chalurbhai Darubhai	„	22 „	„ on 30th January „			
	675, Hari	Female,	65 „	„ on 12th February „			
	675, Hari attacked with plague on 22nd February 1898. Convalescent. There was an interval of one week between the inoculation fever and the bubonic fever.						
Ward No. 4 House No. 12	679, Manor Aju	Male,	50 years	Inoculated on 29th January and 12th February 1898.	678, Ranchod Aju	„	60 „
	681, Jhaver	Female,	30 „	Inoculated on 12th February 1898	680, Kandas Aju	„	35 „
					680, Kandas Aju died of plague on 20th February 1898.		
Ward No. 4 House No. 13	682, Jiva Ranchod	Male,	35 years	Inoculated on 1st February and 12th February 1898.	683, Suraj	Female,	30 years.
	684, Dahili	Female,	4 „	Inoculated on 12th February 1898			
	......				683, Suraj died of plague on 22nd February 1898. Had an abortion.		
Ward No. 4 House No. 18	700, Malhur Khoda	Male,	20 „	„ „	701, Hira Khoda	Male,	8 years.
	702, Harkha Khoda	„	10 „	„ „	704, Nathi	Female,	15 „
	703, Sada	Female,	40 „	„ „			
					701, Hira Khoda died of plague on 1st March 1898. 704, Nathi died of plague on 17th February 1898.		
Ward No. 4 House No. 26	729, Jiva Nana	Male,	45 „	„ „	730, Jita	Female,	38 years.
	......				731, Data	„	10 „
					730, Jita died of plague on 17th February 1898. 731, Data died of plague on 16th „		
Ward No. 4 House No. 30	744, Lakhi	Female,	35 „	„ „	743 (A), Jatan	Female,	60 years.
	......				743, Okha Kuber	Male,	45 „
					745, Divali	Female,	12 „
					743, (A), Jatan died of plague on 19th March 1898.		
Ward No. 4 House No. 31	746, Jiva Galab	Male,	35 „	„ „	747, Sama	Female,	30 years.
	748, Kushi	Female,	9 „	„ „	751, Divali	„	5 „
	749, Nathi	„	5 „	„ „			
	750, Kashi	„	7 „	„ „			
	746, Jiva Galab died of plague on 26th February 1898. Bubonic fever developed 9 days after inoculation. There was an interval of 6 days between the inoculation fever and the bubonic fever.						

Occurrences of Plague in Undhera Village, Baroda Taluka, from the 15th February to the 26th March 1898—concld.

Full Address.	Census Nos., names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of attack or death.	Census Nos., names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of attack or death.
Ward No. 4 House No. 34	759, Sona . Female, 24 years . Inoculated on 12th February 1898 761, Devla Bahadar . Male, 35 „ . „ „	758, Icha Bahadar . Male, 28 years. 760, Vakhat . Female, 50 „ 766, Bhikhia . Male, 30 „ 760, Vakhat died of plague on 23rd February 1898.
Ward No. 4. House No. 35	763, Natha Jesing . Male, 33 „ . „ „ 763, Natha died of plague on 21st February 1898. The bubonic fever developed without interval after inoculation.	764, Jasu . Female, 50 years. 764, Jasu died of plague on 27th February 1898.
Ward No. 4 House No 53	830, Suraj . Female, 50 „ . Inoculated on 26th January and 12th February 1898. 831, Mahiji Girdhar . Male, 10 „ . Inoculated 2nd February and 12th February 1898.	832, Dahi . Female, 7 years. 832 (A), Jesing Girdhar . Male, 28 „ 832, (A), Jesing Girdhar died of plague on 23rd February 1898.
Ward No. 4 House No. 80	927, Madhiya Balavantiya Male, 32 „ . „ on 12th February 1898 930, Ma . Female, 50 „ . „ „ 931, Girdhario . Male, 6 „ . „ „ 934, Harki . Female, 8 „ . „ „	928, Jivi . Female, 28 years. 929, Lakhada . Male, 25 „ 932, Mahulo . „ 3 „ 933, Kasaniyo . „ 6 months. 932, Mahulo died of plague on 23rd February 1898.
Ward No. 4 House No. 84	949, Punjiya Jethiya . Male, 60 years . Inoculated on 12th February 1898. 950, Panadi . Female, 50 „ . „ „ „ 952, Dahyo . Male, 32 „ . „ „ „ 953, Samalo . „ 16 „ . „ „ „ 957, Magani . Female, 30 „ . „ „ „	951, Dudhiyo . Male, 35 years. 954, Dhamatiyo . „ 2 „ 955, Girdhariyo . „ 12 „ 956, Kasani . Female, 28 „ 958, Dhani . „ 2 „ 951, Dudhiyo died of plague on 22nd February 1898. 955, Girdhariyo died of plague on 15th February 1898
Ward No. 4 House No. 89	975, Kankadi . Female, 40 years . Inoculated on 12th February 1898. 976, Mitki . „ 2 „ . „ „ „	974, Kusal Nathiya . Female, 4 years. 974, Kusal died of plague on 15th February 1898.
Ward No. 4 House No. 90	977, Karson Kahinya . Male, 32 years . Inoculated on 12th February 1898. 978, Bai Manadi . Female, 28 „ . „ „ „ 981, Kuvedi . „ 2 „ . „ „ „	979, Dudhali . Female, 8 years. 980, Kasni . „ 6 „ 982, Ramli . „ 70 „ 982, Ramli died of plague on 4th March 1898.

APPENDIX No. IV.

REPORT

ON

THE PREVENTIVE INOCULATIONS AGAINST PLAGUE IN THE KHOJA COMMUNITY OF BOMBAY DURING THE EPIDEMIC OF 1897-98.

BY

MONS. W. M. HAFFKINE.

Total of Khojas inoculated during the epidemic of 1897-98, and their average daily strength.

His Highness the Aga Khan's Inoculation Station at Mazagon was opened on the 27th December 1897. Up to the 20th April 1898, inclusive, 5,000 Khojas (exactly) were inoculated at that station, and 184 others were done in Municipal Stations in the rest of the town, giving a total of 5,184 inoculated during the epidemic of 1897-98.

This number includes Khojas who had been inoculated already last year, during the epidemic of 1896-97, and who presented themselves this year for re-inoculation. On the contrary, the Khojas inoculated last year, but not re-inoculated this year, are not included in the above number, and the analysis which follows does not refer to them.

The above number of Khojas was inoculated gradually. On the 27th December 1897, the opening day of the Station, 33 were operated upon; on the 28th the number increased up to 66; on the 29th it increased up to 119; on the 30th up to 226; on the 31st up to 301; and so on. During the first nine weeks the number was increasing steadily, and on the last day of February it reached 4,719. During the other 7½ weeks the total number increased only by 465. Taking the daily strength of the inoculated during the whole period of 16½ weeks, the average appears as 3,814. In the following comparative analysis the mortality in the inoculated is considered as having occurred not in 5,144 individuals, which is the number reached at on the last days of the operations, but in a number of 3,814 individuals only, which is the *average* daily strength taking the above period as a whole.

The average daily strength of the Khojas who remained uninoculated.

A census of the Khojas of Bombay taken in the beginning of 1898, by the officers of the Khoja Jamat, under the orders of His Highness the Aga Khan, showed the total community to be numbering 9,350 souls.

A certain number of families were, however, away when the census was being taken, on account of the epidemic, and their number could not be obtained accurately.

The following figures are, therefore, taken as giving a safe foundation for all the necessary considerations.

The annual Khoja mortality in years free from plague, as registered in the burial-ground books of the Jamat office, was—

in 1892,—385
„ 1893,—301
„ 1894,—335
„ 1895,—349

giving an average of 342 deaths in a year.

The mean mortality in the population of Bombay is close upon 35 per mille per annum.

Counting for the Khojas a mortality per mille per annum of 25 only, the average of 342 deaths a year gives a population of 13,680, which is likely to be higher than the actual number. During the epidemic of plague which preceded the 16½ weeks under consideration, the Khojas had 350 deaths in excess of their average mortality. The above number of persons in the community should, therefore, be reduced by 350, giving a population of 13,330.

This number, apparently exaggerated, which exceeds that found during the census by nearly 4,000 (by over ⅖), is adopted in the following calculations as representing the real Khoja population of Bombay, and the proportion of inoculated and uninoculated is accepted to be as follows:—

Average daily strength of inoculated	. 3,814	(accurate number).
„ „ of uninoculated	9,516	(approximate, probably exaggerated number, which includes also those inoculated last year and not re-inoculated during the epidemic of 1897-98).
Total	. 13,330	

By thus calculating upon an exaggerated strength of the uninoculated, the risk of exaggerating their death-ratio during the epidemic under consideration is avoided.

Total number of deaths in Inoculated and Uninoculated which took place during the period under consideration.

During the 16½ weeks, between the 27th December 1897 and the 20th April 1898, 184 deaths in all occurred in the Khoja Community. Of these, six, including two of plague, took place in Khojas inoculated in the epidemic of 1896-97, and not re-inoculated since; seven deaths, including three of plague, occurred in the 5,184 Khojas inoculated or re-inoculated this year; and 171 deaths occurred in the uninoculated Khojas.

Number of deaths from plague in Khojas during the period under consideration.

In the years 1892 to 1896, while there was no plague in Bombay, the mortality in Khojas during the same part of the year, between the 27th December and 20th April, was 131, 96, 100, 106 and 96, respectively, or on the average 105, in a normal population of 13,680 individuals. In the reduced population of 13,330 as it stood at the beginning of the period under consideration, it should have been proportionately 102. The advent of the plague may have altered the course of the mortality, namely, the liability to deaths from other causes than plague may have been influenced by the fact that, during the plague year preceding the period under consideration, double the usual number of individuals had been carried away by death. The normal mortality must have been also reduced by a part of the community having left the city. Admitting, however, that, of the total number of 184, fully the usual proportion of 102 died of other causes than plague, there remain 82 deaths in excess of that number which are attributable to plague alone; 64 of this number were actually acknowledged as plague deaths by the relatives of the deceased, or certified as such by the Khoja Jamaat books.

Of the 102 deaths attributable to other causes four occurred in inoculated this year, four in inoculated last year, and the rest, 94, in uninoculated.

Of the 82 deaths attributable to plague, three occurred in inoculated this year, two in inoculated last year, and 77 in uninoculated.

The names, sexes and ages, and full addresses of all these 184 persons are given in the Appendices, Nos. II and IV. These data have been very carefully verified, in all their details, from the Jamat and the inoculation documents, and by means of a minute house-to-house investigation carried out by Mons. Haffkine personally.

The distribution of deaths among the inoculated and uninoculated is as follows :—

> 9,516 uninoculated (probably exaggerated number) had 77 deaths from plague and 94 deaths from other causes.
>
> 3,814 inoculated this year (accurate number) had three deaths from plague and four deaths from other causes.

Admitting that among the uninoculated not more than the above proportion of deaths was due to plague, and supposing that the inoculated had remained, after inoculation as susceptible to disease as were the uninoculated, they should have had, according to their relative strength, 31 deaths from plague and 38 deaths from other causes.

The actual result is the most striking of all that have been observed up to now.

Among the 77 uninoculated who died of plague, there was one babe below three years of age, and four people above 60, giving a total of five deaths. Among the 94 uninoculated who died of other causes than plague, there were 33 deaths in babies of three years and below, and 23 in people above 60, giving a total of 56 deaths.

The proportion of individuals of these two extremes of ages, who were inoculated, was very considerable, but smaller than their proportion among the uninoculated (see Appendix No. 1). In order to eliminate this source of possible error, the five deaths from plague and 56 deaths from other causes, which occurred in uninoculated outside the age of 3 to 60 years, may be excluded from the comparison altogether, and after that the figures are still as follows :—

> 9,516 uninoculated (probably exaggerated number) had 72 deaths from plague and 38 deaths from other causes.
>
> 3,814 inoculated (accurate number) had three deaths from plague and four deaths from other causes.

The difference in the mortality in the uninoculated and inoculated Khojas.

This represents a difference of 89·7 per cent. of deaths from plague in favour of the inoculated part of the community, and of 73·3 per cent. of deaths from what has been returned as "other causes," in favour of the same part of the community.

After making all allowances for inaccurate classification of deaths in the uninoculated group, with which the inoculated is being compared, and admitting that a part of the excess of deaths in the uninoculated may be due to a certain number of sickly people having abstained from inoculation, the result still contains an indication that, besides the protection against plague, this inoculation influences also favourably the resistance to certain other diseases than plague, a fact with regard to which exact material is since some time being accumulated in the Research Laboratory.

W. M. HAFFKINE.

THE PLAGUE RESEARCH LABORATORY,

Bombay, 10th of May 1898.

APPENDIX No. I.

Table permitting of a comparison between the inoculated and uninoculated groups of Khojas as regards their sexes and ages :—

Ages.		Up to 3 years.	4 to 7 years.	8 to 15 years.	16 to 45 years.	46 to 60 years.	61 years and upwards.
Number of uninoculated Khojas as found in Bombay during a house-to-house visitation in March 1898.	Males . .	190	232	455	1,270	222	93
	Females . .	209	270	525	1,122	181	83
	TOTAL . .	399	502	980	2,392	403	176
Number of inoculated Khojas registered at the Khoshroo Lodge Inoculation Station between 27th December 1897 and 25th April 1898.	Males . .	133	254	698	1,239	153	48
	Females . .	133	281	644	1,166	239	25
	TOTAL . .	266	535	1,342	2,405	392	73

APPENDIX No. II.

(*To be compared with Appendix No. IV.*)

NAMES AND PARTICULARS OF THE *inoculated* KHOJAS WHO DIED BETWEEN THE 27TH DECEMBER 1897 AND 20TH APRIL 1898.

Names and particulars of the seven Khojas inoculated during the Epidemic of 1897-98 who died of Plague or other causes :—

(*a*).—*Died of Plague.*

Mahamad Visram, male, 24, of Palla Galli.

Purbai, wife of Punja Ladha, 55, of Chinchpokli.

Mirium, grand-daughter of Hassam Somji, 3 years of Kandi Moholla.*

(*b*).—*Died of other causes.*

Katija, daughter of Naoroji Jan Mahamad, 2½ years, of Darga Moholla.

Mithibai, wife of Hassan Ladha, 24 years, of Khadak.

Chagbai, wife of Jan Mahamad Virji, 50 years, of Kandi Moholla.

Gulam Husein Alladin, male, 20 years, of Khadak.

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* See Dr. M. B. Lam's letter, next page.

Names and particulars of the six deceased Khojas inoculated during the Epidemic of 1896-97, who died of Plague or other causes during the period between the 27th December 1897 and 20th April 1898 :—

(*a*).—*Died of Plague.*

Gulam Huscin Merally, grandson of Hasam Shivji, 6 years, of Darga Moholla.

Sakinabai, wife of Dost Mahamad Hasan, 25 years, of Dongri.*

(*b*).—*Died of other causes.*

Sakina, daughter of Jivraj Asar, 11 years, of Two Tanks.

Rehmatbai, wife of Samji Hirji, 20 years, of Kandi Moholla.

Fatma, daughter of Ismail Asar, 12 years, Jamatkhana, Dongri.

Sakinabai, wife of Musa Jaffer Pardhan, 19 years, of Palla Galli.

APPENDIX No. III.

RESULT OF THE ENQUIRY AS TO THE CAUSE OF DEATH IN *inoculated* KHOJAS WHO DIED OF DISEASES OTHER THAN PLAGUE, OR OF DOUBTFUL CAUSES.

The following circular letter was sent round to all the medical practitioners who were reported by the relatives to have treated the deceased during their illness :—

PLAGUE RESEARCH LABORATORY, MAZAGON :

Bombay, 28th April 1898.

To

Dr.__________________(name of the Physician).

DEAR SIR,

____________________ (name, sex, and age of the deceased), residing at____________________(full address), had been inoculated against Plague on____________(date). He (or she) died on_______________(date), and the parents stated that the cause of death was_____________ (quoted the given cause of death). As I have been informed that the patient had been under your treatment. I write to ask you to kindly let me know what, in your opinion, the real cause of death was and whether there were indications of symptoms which would render it possible to ascribe the death to plague.

W. M. HAFFKINE.

The following replies were received :—

Correspondence regarding Mirium, grand-daughter of Hassam Somji.

From—M. B. LAM, L. M. & S., to PROFESSOR HAFFKINE, dated Bombay, the 3rd May 1898.

Yours of the 28th April to hand. With reference to that, I beg to state that the girl in question, whose case I remember very well, *viz.*, Miriumbai, grand-daughter of Hassam Somji, was brought to me by her father on the morning of the 25th February for fever and cough.

On examination, I found that there was slight congestion of the base of her right lung and consequent dullness with temperature 101°. I prescribed for her ; next day, *i.e.*, on the 26th, the same medicine was taken by her father in my absence.

After the 26th till the date of her death, *i.e.*, 7th March, she was not under my treatment.

Under these circumstances. I am quite unable to form a correct opinion as to the immediate cause of her death.†

Hoping this would serve your purpose.

Correspondence regarding Katija, daughter of Navrozi Jan Mahomed.

From—DOSABHAI K. PATEL, dated Bombay, the 1st May 1898.

In answer to your letter, dated 28th ultimo, I have the pleasure to inform you that Khatija, daughter of Navrozi Jan Mahomed, died of tubercular meningitis, and not of plague.

She was suffering for a long time and had no symptoms of plague.

Correspondence regarding Mithibai, wife of Hassan Ladha.

From—J. B. DEQUADROS, L. R. C. P., to PROFESSOR W. M. HAFFKINE, C.I.E., dated Khadak, the 5th May 1898.

With reference to your letter of the 28th of April 1898, regarding one Mithibai, wife of Hassan Ladha, Khoja, aged 25 years, residing at Nishanpada Street, No. 106, who had been inoculated against plague twice this year, and died on the 8th of April 1898, I hereby declare that she was under my treatment for choleraic diarrhoea, which brought about miscarriage.

This shortened the life of the patient. There was no symptom whatsoever to render it possible to ascribe the death to plague.

Correspondence regarding Chagbai, wife of Jan Mahomed Virjee.

I.

From—ERACHSHAW JAMSHEDJEE HAKIM, to DR. W. M. HAFFKINE, dated Fountain House, Mahableshwar, 2nd May 1898.

I have received your letter about the supposed cause of death of my patient Bai Chagbai. About six months before, when she was under my treatment, she was suffering from chyluria and elephantiasis about her mammary glands, with high fever, also she was suffering from fatty degeneration about the heart.

I think she must have died from a severe attack of cellulitis consequent from the previous nature of her disease.

II.

From—HIRJIBHOY JAMSETJI APPOO, L. M. & S., to PROFESSOR W. M. HAFFKINE, dated Khetwady, 12th Lane, Bombay, 2nd May 1898.

In reply to your enquiry of the 28th ultimo, regarding Chagbai widow of Jan Mohammed Virjee, Khoja, I beg to state that Chagbai was subject to periodic attacks of elephantiasis of the breasts. The last attack was an exceptionally strong one, the fever and inflammation being of a more aggravated character, affecting the head, producing delirium and coma, ending in death on the 3rd April last.

I am of opinion that the cause of death was ***not*** plague at all, but elephantiasis of the breast.

Correspondence regarding Gulam Hussain Aladin.

From—A. F. PEREIRA, to W. M. HAFFKINE, Esq., dated Khadak, the 8th May 1898.

Gulam Hussain Aladin died of phthisis; no signs of plague about him. I am unable to give you any information about Sakina, daughter of Jivraj Asar. I believe Dr. Blaney treated her.‡

Correspondence regarding Sakinabai, wife of Dost Mahomed Hassan.

I.

From—ISMAIL JAN MAHOMED, to DR. HAFFKINE dated 22, Falkland Road, Bombay, the 6th May 1898.

Many thanks for your letter of the 4th May. Sakinaba, wife of Dost Mahomed Hassan, Khoja, female, 25 years, was residing at 2nd Chinch Bunder Road, No. 583—585. She was under my treatment for fever ; after confinement, she had puerperal fever ; she did not suffer from plague.

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* With regard to the patient see Dr. Ismail Jan Mahomed and Dr. Bahadurji's letters below.

† The symptoms admitting the possiblity of pneumonic plague, the case is accepted as being a case of plague in inoculated (see Appendix No. II, previous page), on the same principle as mentioned in the foot-note on page following.

W. M. HAFFKINE.

‡ See on next page another letter from Dr. A. F. Pereira and the letters from Drs. Blaney and Hakim.

II.

From—Dr. K. N. Bahadurji, to W. M. Haffkine, Esq., C. I. E., dated Bombay, the 19th May 1898.

It appears that the case of Sakinabai at Chinch Bunder you refer to was seen by me with Dr. Ismail J. Mahomed. My impression was that the case was one of plague. But Dr. J. Mahomed who watched the case before and after my seeing her assures me that she died of puerperal fever. I have had similar cases to treat in my hospital and they were taken as plague septicæmia.*

Correspondence regarding Sakina, daughter of Jivaraj Assar.

I

From—A. F. Pereira, to W. M. Haffkine, Esq., dated Khaduck, the 19th May 1898.

I have inquired from the Khoja Jamat Khana and I am given to understand that Sakina, daughter of Jivraj Assar, died of consumption.

II.

From—Thomas Blaney, Esq., dated 9th May 1898.

I only saw the deceased girl, Sakina, at long intervals. She was suffering from advanced phthisis. I heard nothing about inoculation during life, and only know of her death from her friends. I am unable to say whether she had plague during any period of her illness.

III.

From—Erachshaw J. Hakim, to Dr. W. M. Haffkine., dated Mahableshwar, 8th May 1898.

In reply to your letter of the 4th May 1898, about the cause of death of Bai Sakina Jairaj Asar, who was inoculated on the 1st April 1897, and who died on 5th March 1898, of phthisis, I have some reason to believe, not by mere bare imagination, that in certain constitutions this serum has some tendency to weaken the body and develop or hasten to a state of consumption.

A Parsi girl of sound constitution and no hereditary predisposition was inoculated at Poona on the 25th March 1897 at the Council Hall. Three months after she began to suffer from slight fever and now she shows some signs of phthisis. The patient's name is Bai Merbaiji Rustamji Byramji Jijibhoy.

P. S.— If you believe this possibility in some cases, and if you know or advise something which may do some good in such class of cases, kindly let me know about it.

IV.

Reply by Dr. W. M. Haffkine to Dr. E. J. Hakim's question, dated Bombay, 9th May 1898.

I thank you for the information contained in your letter of 8th instant. I am forwarding to your address a pamphlet on the protective inoculation against plague, where, on page 6, you will find the answer to a question similar to yours, which had been put to me by Dr. S. H. Mody.

You will see from the report, which will be published shortly, on the mortality among Khojas during the first quarter of the current year, that in 3,814 inoculated Bombay Khojas seven deaths from all causes have occurred, including that of your patient, Bai Sakina Jivraj Asar, while in 9,516 uninoculated there were 171 deaths from all causes.

This shows that there is no ground whatever to ascribe to inoculation the causing of any disease or the hastening of death from any cause,—seeing that the *total* mortality in inoculated was so strikingly smaller than the total mortality in persons who had not been inoculated.

Thanking you again for the information supplied.

Extract from the pamphlet on "The Protective Inoculation against plague," dated Poona, 3rd January 1898, mentioned in the letter from Dr. W. M. Haffkine, to Dr. Erachshaw J. Hakim.

Q.—Is it a fact that persons who are predisposed to certain diseases get the same degree of excitement after inoculation?

A.—Originally we were on our guard against that, and we adopted once for all the following proceeding. Every time a person who wishes to be inoculated informs us that he is suffering from any chronic or recurring complaint, we allow him to get first a very mild, tentative dose. If that dose does not cause him any inconvenience, we give him either the rest in one injection, or, if there is reason to be cautious, we continue to divide the rest into fractions. We have never had reason to ascribe the least ill-effect to the operation, and very soon we adopted the rule to refuse it only to persons who have *fever* on them at the time when they present themselves for inoculation, or who had fever a day or two before. This exception is made for two reasons:

(1) A person having fever on him may be in the beginning stage of plague. Although, in our experience, we had no indication that inoculation aggravates the condition of such a person, it is not likely, however, to effect any good either. Under these circumstances, and seeing that such cases are likely to create confusion in the public mind as to the effect of inoculation, it is important to avoid them as carefully as possible.

(2) If a person is suffering from any other fever, for instance, from an attack of malaria, the addition of the inoculation fever, coinciding with his own attack, may make him more than necessarily uncomfortable, and create analogous confusion as to the amount of reaction caused by inoculation.

In considering this question in general, one has to take into account the following circumstances: As I mentioned already, we inoculated in Bombay alone during the last cold season† close upon 8,200 persons. The age of these persons varied between 3 months and 83 years, no exception being made for persons of whatever constitutional disorders. Under these circumstances, one may fairly admit that the inoculated, as regards their liability to general sickness, represented nearly the same average as the majority of the Bombay inhabitants. Now, under the best conditions, in an ordinary healthy year, without any abnormal influences of weather or other factors predisposing to sickness, the mortality in Bombay is close upon 35 per mille per annum. An average number of 8,200 people in Bombay should, therefore, have in a year not fewer than 246 deaths. For every person who actually dies in the course of a year there are probably not less than 3 who start some ailment, or contract for the first time some disease not actually fatal. So that, in a healthy year, in Bombay, 8,200 persons should have some 984 persons passing from a good state of health into an indifferent or bad one, or actually struck by death, without reference to any inoculation whatever.

The thousands of inoculated who do not happen to belong to this unfortunate group of 984, and who feel absolutely as fit after the inoculation as they felt before, do not say a word about it, and their existence does not attract attention. This is as it should be; but, at the same time, when one comes across a person who says he feels unwell in this year, consecutive to the time of his inoculation against plague, it does not follow that his case is due to the inoculation.

In order to be absolutely sure in our reasoning, let us admit that, of the above number, 365 persons only, or as many as there are days in a year, instead of the 984 calculated above, should, in the ordinary course of events, pass from a good state of health into a bad one. This alone will show that we may have at least one person every day in the year who will begin to feel unwell from the day of inoculation, without this fact being due in the least to the fact of inoculation.

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* The opinion that the case was due to plague was adopted (see Appendix No. II, *supra*), as in all contradictory statements the view adverse to the inoculation is given preference in these Reports.

† *i.e.*, during the epidemic of 1896-97.

Correspondence regarding Rehmatbai, wife of Samji Hirji.

From—Dosabhai K. Patel, to Professor W. M. Haffkine, C.I.E., dated Khadak, Bombay, the 27th May 1898.

In answer to your letters, dated 5th and 13th instant, I have the honour to inform you that I don't remember having treated Rehmatbai, wife of Samji Hirji, aged 20 years. But on careful enquiry I find that she died of phthisis, and not of plague.

Hoping to be excused for the delay.

Correspondence regarding Fatma, daughter of Ismail Assar.

From—A. G. Viegas, to Professor W. M. Haffkine, C.I.E., dated 9th May 1898.

Fatma, daughter of Ismail Assar, died from tubercular consumption. This is all the information I can give you in reply to yours of the 4th instant, and can emphatically say that she did not die of plague.

Correspondence regarding Sakinabai, wife of Musa Jaffer Pardhan.

I.

From—B. S. Shroff, to Professor W. M. Haffkine, C.I.E., dated Chinch Bandar, Bombay, the 11th May 1898.

In reply to your letter No. 190 of 1898, I beg to say that Sakinabai wife of Mr. Musa Jaffer Pardhan, died of tuberculosis of the stomach. She was in a fair state of health after inoculation in April 1897. Subsequently she had been in the family way and delivered a son in November 1897. After delivery, she suffered from intermittent fever, cough and irritability of the stomach. She did not die of plague or its sequelæ.

II.

From—J. Accacio DaGama, to Monsieur W. M. Haffkine, dated Khoja Molla, the 9th May 1898.

I have to acknowledge the receipt of your letter No. 194 of 1898 yesterday.

In reply, I have to say that I treated Sakinabai, wife of Musa Jaffer, in the months of November and December last, and saw her last on the day of her death, which took place on 19th March 1898. She was suffering from stomatitis and extreme debility of the intestinal canal, accompanied by vomiting and chronic diarrhœa and fever, of which she died. There were not the slightest symptoms of plague in the case.

From—R. N. Khory, to Professor W. M. Haffkine, dated Bombay, the 9th May 1898.

Your kind note, dated the 4th May, came to hand this morning, the envelope bearing the post office delivery mark of the 8th instant.

I well remember the patient, Sakinabai, residing at Dongri. She was ill with gastric ulcer and pain in the epigastrium due to that cause. She had had fever of a hectic character.

It was not at all possible to connect the cause of her death with any indications or symptoms which could be ascribed to plague.

APPENDIX No. IV.

Names and particulars of the *uninoculated* Khojas who died between the 27th December 1897 and 20th April 1898.

Mazagon.

Shakerbai, daughter of Ahmed Nandoo, 11 years, Nesbit Lane, Aga Hashamshah's house in His Highness Aga Khan's residence, died of plague in the Khoja Hospital on the 6th January 1898.

Parel Road, Lalwadi.

Noormahomed Tarmahomed Dharamsi, 22 years, Parel Road, near Richardson, Cruddas and Company and near house No. 625, died of plague at home on 15th February 1898.

Setbai, daughter of Tarmahomed Dharamsi, 12 years Parel Road, near Richardson, Cruddas and Company, house No. 625, died of plague in the Khoja Hospital on 17th February 1898.

Moti, wife of Alibhoy Mahomed, 18 years, Lalwadi, Parel, No. 104, died on 27th February 1898.

Hussein, son of Karim, grandson of Poonjab Ladtha, 6 months, Chinchpoogli, Parel Road, died on 1st March 1898.

Nagji Tejpal, 70 years, Kali Chowki Road, No. 160, died on 11th March 1898.

Byculla.

Aladin, son of Hirji Lowji Babool, 30 years, Haines Road, No. 102, died of plague in the Khoja Hospital on 10th January 1898.

Ludha Jaitha, 85 years, opposite Victoria Gardens, near Tramway Company's stables, died on 30th March 1898.

Mahomed Khimji Nanji, 30 years, Haines Road, No. 212, died on 7th April 1898.

Jacob's Circle, Sat Rasta.

Ali Munji, 34 years, Nagdevi Road, died of plague in the Khoja Hospital on 14th January 1898.

Nagpada.

Dhunji Megji, 50 years, Underia Street, died of plague in the Khoja Hospital on 3rd March 1898.

Sekina, grand-daughter of Gangji Haji, 6 months, Memon-wada Street, No. 506—508, died on 1st April 1898.

Kamatipura.

Koowarbai, daughter of Manji, and wife of Purdhan Mitha, 26 years, Kamatipura Centre Road, opposite the Church, died of plague at home on 13th February 1898.

Noormahomed Damji, 56 years, Kamatipura Centre Road, near house No. 122, died on 12th April 1898.

Dunkey Dole (Duncan Road).

Fijibai, daughter of Pirbai Khanbai, daughter-in-law of Ali Haji, 20 years, Upper Duncan Road, house No. 64, died of plague at home on 30th December 1897.

Coorji Ruttansi, 65 years, Duncan Road, No. 502, died on 19th January 1898.

Two Tanks.

Rehim Punchan, 35 years, English Road, near the Parsees' Aghiari (fire-temple), died of plague in the Khoja Hospital on 23rd February 1898.

Kanda Wadi.

Sherbanu, daughter of Alarakhia Karim, niece of Munji Karim, 1¼ years, Mugbat Lane, No. 10, died on 17th January 1898.

Dosa Kasim, 70 years, Khoja-Moholla, opposite the Bene-Israel Synagogue, close to Khoja Hospital, died of plague at home on 4th February 1898.

Minbai, mother of Munji Karim, 60 years, Mugbat Lane, No. 10, died on 10th February 1898.

Khetwadi.

Mooloo Alarakhia, 46 years, Khetwadi, Falkland Road, died of plague in the Khoja Hospital on 7th January 1898.

Nul Bazar.

Sivji Jaffer Dhenidina, 25 years, Falkland Road, died of plague in the Khoja Hospital on 16th February 1898.

Khensabai, wife of Rejabali Rehim, 21 years, Khoja Street, No. 8, died on 28th February 1898.

Bhendi Bazar.

Prembai, wife of Bana Ismail, 60 years, Chibutgalli, No. 124, died of plague at home on 1st February 1898.

Suntok, daughter of Jeto, mother of Hasam Jooma, 65 years, No. 126, Parel Road, Bhendi Bazar, died on 5th February 1898.

Walbai, wife of Ahmed Munji, 50 years, Park Mo Street, opposite Mussafar Khana, died on 6th March 1898.

Sarakhanu, daughter of Mahomed Varin, 9 months, Par Road, No. 410, died on 17th April 1898.

Kandi Moholla.

Mahomed Munji, 35 years, Kandi Moholla, died of plague in the Khoja Hospital on 29th December 1897.

Ramji, son of Gulam Husein, 6 months, Tandel Street, Chatriserang Moholla, died on 14th January 1898.

Khimji Kasam, 56 years, Kandi Moholla, died of plague in the Khoja Hospital on 3rd February 1898.

Nanbai Megji, daughter-in-law of Datoo Revji, 14 years, Kandi Moholla, died of plague at home on 3rd February 1898.

Janbai, daughter of Punja Jesraj, 4 years, Kandi Moholla, died on 3rd February 1898.

Nur Mahomed Poonja, 30 years, Kandi Moholla, died of plague in the Khoja Hospital on 16th February 1898.

Soni, daughter of Juma and grand-daughter of Hasam Khimji, 1½ years, Kandi Moholla, Baba Street, died on 16th February 1898.

Miriambi, daughter of Devraj Kalian, 16 years, Kandi Moholla, died on 2nd March 1898.

Jetha, Alana's son, 15 days, Kandi Moholla, died on 7th March 1898.

Sonbai, wife of Sheriff Dosa, 25 years, H. H. the Aga's Chawl, died of plague in the Khoja Hospital on 17th March 1898.

Janbai, wife of Velsi Megji, 50 years, H. H. the Aga's Chawl, died on 10th April 1898.

Durga Moholla.

Fatmabai, daughter of Wali, Ahmed Hamir's wife, 14 years, Kasai Galli, 2nd Dotar Street, Khoja Moholla, died of plague in the Khoja Hospital on 2nd January 1898.

Monghi, daughter of Isa Nundoo, 1½ years, Nishanpada Cross Street, died on 8th January 1898.

Gulam Husein Manek Haji, 32 years, Corner of Bengalpura Nisandarpara Street, died on 11th January 1898.

Nanbai, wife of Jiva Moolji, 75 years, Bengalpura, Nisanpara Road, No. 241, died on 11th January 1898.

Janbai, wife of Gangji Sajoo, 56 years, Darga Moholla, died of plague at home on 12th January 1898.

Jan Mahomed, son of Pira Moolji, 12 years, Tandel Street, died of plague at home on 14th January 1898.

Teijbai, wife of Ravji Alarakhia, 25 years, Corner of Bengalpura, Nisandarpara Street, died of plague in the Khoja Hospital on 16th January 1898.

Fulbai, wife of Kanji Mahada, 54 years, Bengalpura, Nisandarpara Road, No. 241, died on 17th January 1898.

Sekinabai, daughter of Jaffer Remoo, 12 years, Shatrisarang Moholla, died of plague in the Khoja Hospital on 22nd January 1898.

Permabai, wife of Sumar Dama, 50 years, Palkhi Moholla, died of plague in the Khoja Hospital on 24th January 1898.

Hasam Kasam, 35 years, Bengalpura, Nisandarpara Road, House No. 241, died of plague in the Khoja Hospital on 26th January 1898.

Jenab, daughter-in-law of Remtoola Ladha, 17 years, Bengalpura Street, House No. 432, died on 28th January 1898.

Fatmabai, daughter of Lalji Molu Alarakhia, 24 years, Palkhi Moholla, near the Hindu temple, died on 28th January 1898.

Ratanbai, wife of Manji Asar, 52 years, Chatrisarang Moholla, died of plague in the Khoja Hospital on 30th January 1898.

Kulsambai, daughter of Rehemtula Ladha, 11 years, Bengalpura Street, House No. 432, died of plague at home on 30th January 1898.

Munji Asar, 60 years, Chatrisarang Moholla, died of plague in the Khoja Hospital on 31st January 1898.

Mohamed, son of Bhanji Visram, 20 years, Palkhi Moholla Lane, died of plague in the Khoja Hospital on 1st February 1898.

Sirinbai, daughter of Kerim Kassam, 6 months, Tandel Street, House No. 35, died on 1st February 1898.

Jinabai, daughter of Jivaraj Vainya, 9 months, Chatrisarang Moholla, died on 1st February 1898.

Gangabai, wife of Asar Premji, 65 years, Bengalpura, Nisandarpara Street, House No. 250—252, died on 5th February 1898.

Herji Dunger, 70 years, Nisanpara, died on 5th February 1898.

Lalji Parpia, 65 years, Tandel Street, died on 5th February 1898.

Siribai, daughter of Sumar Gulam Husein, 12 years, Bengalpura Nisanpada Road, House No. 241, died of plague in the Khoja Hospital on 10th February 1898.

Pirbhai Somji, 52 years, Nisanpara, House No. 127, died on 15th February 1898.

Juma Kasam, 40 years, Tandel Street, No. 81, died on 17th February 1898.

Nazarali, son of Revji Punja, 12 years, Mahomed Sajan's house at Darga Moholla, died of plague in the Khoja Hospital on 28th February 1898.

Alibhoy Jiva, 22 years, Bengalpura Nisandarpara, died of plague in the Khoja Hospital on 1st March 1898.

Dhunbai Walji Revji, 65 years, Tandel Street, No. 142, died on 5th March 1898.

Mahomed Ruttansi, 60 years, Old Bengalpura Street, No. 257, died of plague in the Khoja Hospital on 6th March 1898.

Rehimtula Aladin Munji, 16 years, Umarkhadi 2nd Road, No. 59, died of plague in the Khoja Hospital on 9th March 1898.

Ratanbai, mother of Giga Visram, 90 years, Bengalpura, Nisandarpara, died on 11th March 1898.

Puribai, mother of Somji Mavji, 60 years, Bengali Street, died on 14th March 1898.

Khanubai, wife of Molu Kasam, 27 years, Bengalpura Street, No. 389, died on 15th March 1898.

Siribai, daughter of Fazul Alarakhia, 2½ years, Darga, Moholla, died on 15th March 1898.

Manbai, wife of Nathu Abhu, 46 years, Nishanpada Street, House No. 98, died on 17th March 1898.

Khatija, daughter of Jan Herji, 7 months, Chatrisarang Moholla, died on 19th March 1898.

Ruttansi Mavji, 65 years, Nishanpada Street, died on 21st March 1898.

Bhanbai, wife of Mahomed Najak, 55 years, Nishanpada Street, died on 22nd March 1898.

Ibrahim, son of Giga Visram, 6 months, Nishanpada Street, died on 25th March 1898.

Miriumbai, daughter of Premji Ruttansi, 7 years, Nishanpada Street, House No. 185, died on 26th March 1898.

Jainabai, daughter of Jaffer Megji, 14 years, Nishanpada Cross Road, No. 39, died on 26th March 1898.

Siribai, daughter of Jairaj Pira Virji, 5 years, Nishanpada Street, died on 30th March 1898.

Bachu, son of Jivraj Pira, 4 months, Nishanpada, died on 5th April 1898.

Khatijabai, daughter of Navroz Lila Ibji, 8 months, Nishanpada Street, died on 5th April 1898.

Hurbai, wife of Mahomed Piru, 80 years, Tandel Street, died on 6th April 1898.

Sikinabai, daughter of Munji Bhanji, 11 years, Nishanpada Cross Road, House No. 39, died on 8th April 1898.

Ruttonbai, wife of Mitha Daya, 80 years, Darga Moholla, died of plague in the Khoja Hospital on 9th April 1898.

Teijbai, wife of Versi Devji, 65 years, Durga Moholla Nishanpada Road, Alarakhia Keshwarni's house, died on 18th April 1898.

Mirium, daughter of Dawud Juma, 1¼ years, Nishanpada Street, died on 19th April 1898.

Umarkhadi.

Alli Haji, Mahomed Sumar's brother's son, 18 years, Umarkhadi, died of plague at home on 15th January 1898.

Sunderji Kurim, 4 years, Jail Road, East House, No. 50, died on 27th February 1898.

Khadak Road.

Hirabai Raoji, daughter-in-law of Dosa Mavji, 28 years, Khadak Road, died of plague in the Khoja Hospital on 29th December 1897.

Kara, Jaitha's wife, 75 years, Khadak Road, died on 5th January 1898.

Sakinabai, daughter of Mirali Premji and grand-daughter of Premji Jeraj, 6 months, Khadak Road, died on 9th January 1898.

Fatmabai, daughter of Mirali Premji and grand-daughter of Premji Jeraj, 1½ years, Khadak Road, died on 14th January 1898.

Rehemtula Khaki Pudemsi, 33 years, Khadak Road, died on 15th January 1898.

Abba, son of Premji Jivraj, 1 year, Khadak Road, died on 29th January 1898.

Sherbanoo, daughter of Amersi Sheriff, 1½ years, Khadak Road, died on 4th February 1898.

Jairaj Thaver's daughter, 3 years, Khadak Road, died on 12th February 1898.

Mahomed Pira Megji, 28 years, Khadak Road, died on 17th February 1898.

Ali Raja Suleman, son of Kasan Ali, Ali Raja, 2 years, Khadak Road, died on 20th February 1898.

Ibrahim Hassam Munji, 35 years, Khadak Road, died on 24th February 1898.

Manbai, wife of Ibram Mitha of Chival—Revadanda, 41 years, Khadak Road, died on 10th March 1898.

Pala Gulli.

Fazul, son of Hasam Teja, 22 years, Munda Gulli, died on 10th January 1898.

Janbai, daughter of Virji, and wife of Miralli Hamir, 32 years, Samuel Street, House No. 268—270, died on 12th January 1898.

Gulam Husein Lala, 55 years, Samuel Street, house No. 308—314, died of plague in the Khoja Hospital on 19th January 1898.

Siribai, daughter of Ladha and wife of Hamir Juma, 30 years, Samuel Street, House No. 308—314, died on 18th February 1898.

Remat, daughter of Sachu Alarakhia, 4 years, Munda Gulli, died on 24th March 1898.

Nur Mahomed, brother of Dhunji Ragu, 58 years, Samuel Street, House No. 326, died on 25th March 1898.

Ismail, son of Alarakhia Munji, 25 years, Munda Gulli, died on 25th March 1898.

Sonbai, daughter of Haji Murji, 10 years, Munda Gulli, died on 2nd April 1898.

Bhalu Tharia, 62 years, Samuel Street, died on 4th April 1898.

Remtala Piru, 65 years, Munda Gulli, died on 12th April 1898.

Jainab, wife of Nazerali Karva, 16 years, Parel Road, died on 14th April 1898.

Sherbanu, wife of Muradali Purdhan, 16 years, Samuel Street, died on 16th April 1898.

Dungri Street.

Bendali Pudemsi, 43 years, Nagdevi Street, near old Post Office, died on 29th December 1897.

Kerim Nathu Sivzi, 28 years, 2nd Chinchbunder Road, died of plague at home on 4th January 1898.

Mavji Anand, 70 years, Chinchbunder 2nd Road, House No. 572, died of plague in the Khoja Hospital on 7th January 1898.

Ranbai, wife of Rehim Nanji, 60 years, Mahim, near Mahim Bazar, died of plague in the Khoja Hospital on 10th January 1898.

Gulam Husein, son of Megji Mahomed, 8 years, Chinchbunder, 2nd Road, House No. 607, died of plague in the Hospital on 11th January 1898.

Ali Mahomed Vali Casam, 24 years, Dungri Street, died of plague at home on 11th January 1898.

Jina Kara's daughter, 10 days, 2nd Chinchbunder Road, House No. 600, died of plague at home on 11th January 1898.

Jeraj Walji, 55 years, 2nd Chinchbunder Road, died on 12th January 1898.

Chagbai, wife of Mahomed Allu, 60 years, 2nd Chinchbunder Road, died on 15th January 1898.

Saley Khakey's son, 8 months, Dungri Street, died on 1st January 1898.

Rehimtula, son of Sacha Hassam, 8 years, Chinchbunder 2nd Road, died on 21st January 1898.

Dharsi Khaku, 62 years, Dungri Bazar, died on 25th January 1898.

Ganji Aladin, *alias* Gulam Husein, 43 years, 2nd Chinchbunder Road, died on 28th January 1898.

Abdulla, son of Molu Ravji, 2 months, Dungri Bazar, near Palla Gulli, died on 7th February 1898.

Katubai, daughter of Ahmed and grand-daughter of Jan Mahomed Rehim, 8 months, Chinchbunder 2nd Road, died on 8th February 1898.

Bachu, son of Mulji Hasam and grandson of Hasam Gangji, 20 days, Dungri Bazar, Chinchbunder 2nd Road, died on 12th February 1898.

Khatijabi Wilshi, daughter-in-law of Hasa Mahomed, 15 years, 1st Navroji Hill Road, died on 16th February 1898.

Sacha Meluk, 75 years, Samuel Street, died on 6th March 1898.

Kajbai, wife of Ismail Sivji, 36 years, Dungri Street, opposite Jerajbhai Pirbhai water cistern, died on 9th March 1898.

Bachu, son of Meralli Joraj, 1¾ years, 2nd Chinchbunder Road, died about the 10th March 1898.

Ismail Merolli Alarkhai, 17 years, Dungri Street, died of plague in the Khoja Hospital on 17th March 1898.

Kasam Sivji, 54 years, Dungri Street, House No. 575, died on 20th March 1898.

Chandibai, wife of Gulam Husein Dhunji, 15 years, Navroji Hill 1st Road, House No. 169, died on 27th March 1898.

Fatmabai, daughter of Fazul Miralli, 6 months, Dungri Street, House No. 564, died on 27th March 1898.

Sekinabai, daughter-in-law of Abdulla Sivji, 28 years, Chinchbunder 3rd Road, House No. 595, died of plague in the Khoja Hospital on 7th April 1898.

Devan Ban, mother of Gulam Hussein Remtala, 72 years, Dungri Street, House No. 581, died on 10th April 1898.

Kasam Jaitha, 58 years, corner of Dungri Street and Samuel Street, died on 10th April 1898.

Dost Mahomed Hasam's daughter, 1½ months, Dungri Street, 2nd Chinchbunder Road, house No. 583—585, died on 16th April 1898.

Rimtula, son of Dhunji Kasam, 30 years, Chinchbunder, 1st Road, died on 18th April 1898.

Khoja Moholla.

Mirium, daughter of Bhanj Poonja, 9 years, Kasai Gulli, 2nd Doter Street, died of plague in the Khoja Hospital on 27th December 1897.

Miriumbai, daughter of Vali Poonja, 10 years, Kasai Gulli, 2nd Doter Street, died of plague in the Khoja Hospital on 1st January 1898.

Lalbai, wife of Kermali Haji, 35 years, Khoja Moholla, died of plague in the Khoja Hospital on 19th January 1898.

Abdul Kerim Abdul, 22 years, Khoja Moholla, died on 23rd February 1898.

Mahomed Rehemtula, 35 years, Mugbat Lane, House No. 10, died of plague at home on 23rd February 1898.

Hasam Nensi Kheraj, 23 years, Khoja Moholla, died of plague at home on 13th March 1898.

Abas Mahomed Dosa, 12 years, Kasai Gulli, 2nd Doter Street, died of plague at home on 13th February 1898.

Chagbai *alias* Ruttonbai, wife of Gulam Husen Munji, 42 years, Kumbharwada Cross Lane, died of plague in the Khoja Hospital on 31st March 1898.

Furniture Bazar.

Meralli Dhunji, 54 years, Bandari Street, died of plague in the Khoja Hospital on 27th December 1897.

Kasam Munji, 45 years, Chakla Street (Old Kasai Street), House Nos. 7, 9, 11, died on 27th December 1897.

Nur Mahomed, son of Virji Herji, 12 years, Bandar Street, Chakla Road, died of plague in the Khoja Hospital on 29th December 1897.

Nur Mahomed, Sekiladtha, 75 years, Gavli Moholla, died on 5th January 1898.

Ali Mahomed, son of Vali Datu, 8 months, Chakla Street, died on 15th January 1898.

Pudmabai, wife of Arad Merav, 67 years, 2nd Bundarwada Street, died on 15th February 1898.

Janbai, wife of Pirbhai Bhemji, 66 years, Bandari Street, died on 23rd February 1898.

Janbai, wife of Ibrahim Kasam and daughter of Pirbhai, 62 years, Chakla Street, House No. 11, died of plague in the Khoja Hospital on 3rd March 1898.

Sekinabai, wife of Pirbhai Alarakhia, 20 years, Chakla Street, House Nos. 7, 9, 11, died on 6th March 1898.

Gangji Pissu, 72 years, Bandari Street, died on 20th March 1898.

Fatma, daughter of Kassam Remtula, 8 years, Kalasi Chakla Street, died of plague in the Khoja Hospital on 5th April 1898.

Nur Mahomed Wali, 40 years, Chakla, Street, died on 5th April 1898.

Gulam Husein, son of Meralli Koorji, 9 months, Chakla Street, died on 18th April 1898.

Market.

Alibhai Nanji, 58 years, Nagdevi Road, Bhajipala Lane, died of plague in the Khoja Hospital on 22nd February 1898.

Sekina, daughter of Rehimtula Karim and grand-daughter of Karim Datu, 2 years, Sutar-Chawl, Abdul Rehman Street, died on 11th March 1898.

Saley Mahomed Gulam Husein Somji, 6 years, Khetwad. 12th Lane, died of plague in the Khoja Hospital on 24th March 1898.

Nensi Pirbhai Mahomed, 52 years, Crawford Market, Kitchen Garden, died on 29th March 1898.

Kasam Somji Gangji, 35 years, Nagdevi Street, died on 20th April 1898.

Dhobi Talao.

Walbai, daughter of Walji Punja, 6 years, Dhobi Talao, died of plague in the Khoja Hospital on 28th March 1898.

People without fixed residence.

Rehimtula Nur Mahomed, 28 years, died of plague in hospital on 14th January 1898.

Bhanji Nur Mahomed, 22 years, Israel Street, brought from House No. 23—25, died of plague in the Khoja Hospital on 22nd February 1898,

APPENDIX No. V.

RULES OF PROCEDURE FOR THE PREPARATION OF M. HAFFKINE'S PROPHYLACTIC FLUID.

RULES FOR STERILIZING THE CULTURE FLASKS.

1. All cultivation flasks ready to be sterilized are placed by the testing officer in the inoculation room on a special table designed for that purpose and having a label pasted upon it "Flasks ready for Sterilization."

2. The flasks are to be transferred into the sterilization room by the Sterilizing Officer himself, or by his assistant, under his immediate supervision.

3. Only the precise number of flasks ready to be put immediately into the sterilization tub should be removed from the inoculation room. Any flask which cannot be put into the sterilization tub immediately should be replaced into the incubation room. On no account should unsterilized cultivation flasks be allowed to remain in any part of the Laboratory except the incubation room.

4. A label to be made out for each flask stating its number, the quantity of prophylactic it contains, and adding the word "Heated." The date of heating, however, must not be entered on the label till the flask is removed from the hot water bath and from the cooling tub.

5. The Sterilizing Officer, further, puts his initials in red ink on the original label affixed to the flask.

6. Place the new labels on the plugs of the flask and fix the paper cover on the mouth.

7. Put the cultivation flasks together with the control flask into the water bath and mark in the special note book kept for the purpose the time when the thermometer in the central flask shows 65°C. Leave the flasks in the tub for one hour counting from that moment.

8. On the expiration of the hour, remove from the bath and cool.

9. The original label of the flask to be examined ; and to ascertain that it got either detached in the hot water tub, or that the red ink of the initials shows the effect of the hot water. The new labels to be now removed from where they have been resting on the plugs, the date of heating marked on them and the labels themselves pasted on the sterilized flasks.

10. Note the quantity of prophylactic in c.c. in each flask and add carbolic acid in the proportion of $\frac{1}{2}$ per cent. The total quantity of carbolic acid added to each flask to be marked on the label.

11. Mark the fact of carbolizing and the date on which this was done on the label.

12. In the book kept for the purpose enter the date of heating and carbolizing against the numbers of the flasks heated and carbolized in the respective columns, and state the actual amount of pure carbolic acid added.

13. Flasks are now ready for decanting and should be placed in the special cupboard for the decanting officers.

RULES FOR DECANTING.

1. The decanting officers to take the flasks from the cupboard where the flasks that have been heated and carbolized are kept.

2. Examine closely the label and do not proceed to decant till you learn from it —

(*a*) the fact of its having been heated and carbolized; and

(*b*) the date on which these processes were done.

3. Having satisfied yourself of this, put your initials on the label.

4. Provide yourself with the necessary apparatus for decanting, a stand, a pair of forceps, a clip, sterilized bottles, a sterilized syphon *and sterile agar tubes.* (The words in italics were added on the 12th December 1898.—*W. M. Haffkine.*)

5. Heat carefully the neck of the flask to be decanted, as far as it can be done without cracking the glass, and passing the flame of the burner at the same time over the surface of the plug.

6. Fix the flask on the stand as shown.

7. Sterilize the glass of the syphon to be introduced into the flask by passing it several times through the flames of a Bunsen burner. Next, having sterilized in the same way the ends of the forceps, seize the plug at the mouth of the flask with the latter, remove it partially, and introduce the syphon, pushing afterwards back the plug in place.

8. Fasten the clip in position on the syphon.

9. Immediately before sucking, shake the flask with its contents well round.

10. A suction tube (short rubber tube provided with a cotton plugged glass mouth) is next fitted on to the end of the syphon hanging out of the flask, and the prophylactic is then sucked out from the latter down to the level of the fluid in the flask. The conditions for a current having been thus established, the suction tube is removed, and the end of the syphon very carefully sterilized with the burner.

11. *Take a sterile agar tube and fix it between the thumb and fore-fingers of the left hand ; remove the plug with the forceps and place it between the fore and middle fingers of the left hand, heating gently the mouth of the tube. Sterilize again the end of the syphon, shake the flask well round again and allow some fluid to run through it ; then insert the end of the syphon into the agar tube and allow one drop of the fluid to fall on the top of the surface of the agar slant. Remove the syphon and, sterilizing the mouth of the tube and the cotton plug, re-insert the latter in the former with the sterile forceps. Then write on the labels of the tube the number of the flask, the date and your own initials. The agar tubes thus inoculated to be handed over to Captain Milne.* (This paragraph was added on the 12th December 1898.—*W. M. Haffkine.*)

12. The liquid is then decanted into the sterilized bottles, care being taken —

First—To see that each bottle is perfectly clean and free from cracks ;

Second—To shake the flask between every bottle filled ;

Third—To remove the paper caps protecting the cork, and the cork itself, in the manner prescribed, and to ascertain that the corks are well fitting. Bottles not answering to the conditions prescribed to be rejected ;

Fourth—The end of the syphon, the mouths of the bottles, and the corks to be kept sterile, this being done by repeatedly using the burner.

13. After decanting the whole of the contents of the flask, the number, capacity of, and the number of bottles filled from that flask to be entered in the book kept for the purpose, and the decanting officer's signature affixed against it. A specimen label for the bottles filled, showing the

number of the flask and the date of decanting, to be also made and handed over with the bottles into the sealing room.

14. After the day's work is over all emptied flasks to be submitted to Captain Milne, who affixes his initials on the labels.

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15. The flasks thus passed are placed in the Godown, in charge of the Godown Clerk, who enters their receipt into the Godown book.

16. The bottles of prophylactic sealed up and labelled are handed over into the registering room, whence two sample bottles are sent to Mr. Haffkine.

W. M. Haffkine.

APPENDIX No. VI.

NOTE ON

THE VACCINATION OF ANIMALS AGAINST THE PLAGUE BACILLUS, AND ON THE SERUM OBTAINED THEREFROM.

BY

PROF. A. LUSTIG and DR. G. GALEOTTI,

From the Institute of Experimental Pathology in the Royal University of Florence.

After the discovery of the specific plague bacillus by Kitasato and Yersin, Yersin, Calmette, and Borel began their immunisation experiments to obtain an active serum; that from the horse has shown a curative action also on man,[1] but its efficacy in prevention is not yet well determined. To vaccinate small laboratory animals Yersin used virulent cultures of the plague bacillus attenuated by warming during an hour at 58° C. To vaccinate horses he used small doses of the virulent culture injected into the veins; in all cases the vaccinations were made repeatedly and at intervals to give the animals time to recover from the illness caused by each vaccination.[2]

Kolle [3] states that he had inoculated under the skin in four guinea-pigs and five mice small quantities of virulent cultures killed by prolonged warming at 68° C., and that after sixteen days these animals could bear without any reaction the subcutaneous injection of virulent cultures.

As for us, after having studied in rats, in mice (mus decumanus), in guinea-pigs, and in rabbits the general course of the disorder produced by inoculations of the plague bacillus either under the skin or in the peritoneum, in the veins or in the digestive apparatus, we repeated the immunisation experiments of Yersin with the same results. Yersin's vaccination method, however, with attenuated or virulent cultures is slow, and sometimes dangerous for the animals. After many trials we were able to procure from plague bacilli cultivated in agar of which the virulence was known, a substance free from bacteria which, inoculated in animals in sufficient quantity, is extremely poisonous, and in small quantities makes them quite refractory to the most dangerous forms of infection. From the animals, vaccinated two or three times with this substance in small doses and at intervals of two days, we can obtain a serum with decidedly curative and preservative action.

Our "vaccine" has all the chemical characters of the nucleo-proteids.[4] It is obtained in the following manner: We cultivate the plague bacillus of fixed ascertained virulence for a given animal species in large glass boxes (27 cm. diameter), the bottom of which is covered by a flat stratum of agar 5 to 6 mm. thick. After three days of development at 37° C., or even earlier, we scrape the cultural mass, and we dissolve the scrapings in 1 per cent. caustic potash solution. On the degree of concentration of the solution will depend the active power of the vaccine. This liquid containing the bacilli now dead, as was ascertained by the bacterioscopic examination, and which has become mucilaginous and opalescent, is filtered through a thick layer of paper; with the help of the air pump some distilled water is added. From this liquid we obtained our vaccine by two methods: (1) by precipitation with acetic or hydrochloric acid: or (2) by saturation with sulphate of ammonium after neutralisation. The precipitate, which is more easily obtained with hydrochloric acid, is collected and washed repeatedly on the filter and dissolved in a very weak solution of sodium carbonate.

We have described its reactions elsewhere.[5] It is soluble in alkalies, precipitated easily by acids, and has the same reactions as the albumens. By digestion it gives an insoluble product and a peptone, and by disassociation by means of sulphuric acid it gives some nucleinic bases. Under the microscope the precipitate obtained through the acids and coloured with methyl-blue is seen to consist of amorphous masses, and only contains a few non-coloured bacilli.

We have already alluded to the toxic qualities of this substance. When it is prepared precisely as described above, the smallest dose of the hydrochloric acid precipitate which kills an animal (rats, mice, rabbits) is 8·35 mg. for 190 g. of its weight; and using the precipitate obtained with acetic acid the dose is 5·28 mg. for 100 g. of its weight; if we inoculate this dose in the animals they die in a few hours.

This substance, dissolved in a weak solution of carbonate of soda and filtered through the Chamberland filter, preserves all its properties unchanged. For greater convenience we had dried it *in vacuo* in the presence of sulphuric acid; then for use as a vaccine we dissolved it in an alkaline solution; a portion of it was also passed through the Chamberland filter, and thus any microbe present removed. This last manipulation, however, requires a great deal of time, and causes the loss of a good deal of the active substance as it passes with great difficulty through the Chamberland candle. Both the substance dried and redissolved, and the liquid passed through the filter, have shown excellent vaccinating qualities.[6]

EFFECTS OF THE VACCINATION IN ANIMALS.

Mice (mus decumanus), rats, rabbits, and guinea-pigs vaccinated under the skin or in the peritoneum with doses always smaller than the lethal mentioned above, did not show any general or local morbid phenomena. Not even the morphological elements of the blood were altered except by a slight leucocytosis. If the inoculated substance, however, be very concentrated in the solution, some inflammatory œdema is produced at the point of inoculation, and lasts some days.

The animals vaccinated with small doses on one occasion only, or with the minimum killing dose divided into two or three times, and injected subcutaneously at intervals of two days, show the utmost indifference to the subcutaneous and intraperitoneal injections of a great quantity of virulent culture, while healthy animals of the same weight but not vaccinated treated with the same quantity of culture die in twenty-four hours after the injection in the peritoneum, and some days after the subcutaneous injection. In these experiments we have preferred the injection into the peritoneum both for vaccinated and non-vaccinated animals.

The virulent plague bacillus causes different morbid processes according to the place where the injection is made. If into the peritoneum there is an extremely rapid septicæmia (less than twenty-four hours). In the subcutaneous injection, there is a polyadenitis very much like the natural infection in man, and the animal dies in a week.

If the injection is made in the peritoneum with the attenuative culture, or if the animal is one less liable to plague, then, owing perhaps to a bactericidal action of the peritoneum, we find at first only a slight peritonitis, but a few days later the remaining living bacteria cause the characteristic polyadenitis, and the animal dies. The period between the slight peritonitis and the polyadenitis is five or ten days.

Peritoneal are preferable to subcutaneous injections because they cause an infection which is surely mortal, and so they render it possible to ascertain in less than twenty-four hours the virulence of a culture. We can be sure of the immunity conferred by the vaccination if the animal vaccinated and infected goes beyond the tenth day. Ours did not show any morbid phenomenon after five weeks from the infection, and the microscopic and bacterioscopic examination of those killed after two weeks did not show any plague bacillus in the blood, the spleen, or in the lymphatic glands.

The vaccinated animals are immune from the infection of plague for at least five weeks from the last vaccination. From the animals vaccinated with the minimum lethal doses, divided and inoculated on three occasions at intervals of two days, we obtained after fourteen days a serum with decidedly preventive and curative properties. We have made experiments on rats and mice with the serum of mice or rabbits, and we ascertained that both have the same curative efficacy; 1·0 c.c m. of serum is enough to prevent peritoneal infection, and with the same quantity a rat weighing 180 to 200 g. injected in the peritoneum with a great quantity —4 to 5 platinum needlefuls—of virulent culture is cured. The curative injection of the serum was tested also after injection through the alimentary canal.

We put in a cage seven small mice (mus musculus), and gave them milk in which a virulent culture was dissolved. Three of them died after three days, and in their blood plague bacilli were found; the other four were severely ill with the characteristic symptoms. We injected in them 0·33 c. cm. serum from a vaccinated rabbit, and all survived. At the present moment we are vaccinating a horse to obtain a curative serum.

Our substance can be regarded as harmless for man, because, when inoculated under the skin in doses of 5 mg. dissolved in sterilised alkalised water it causes only a slight local œdema lasting twenty-four hours. The body temperature is, during the first hours, slightly under the normal; then there is slight fever; the urine is normal; a little prostration and uneasiness is felt. We have inoculated it under the skin of our arms and have besides vaccinated four other persons.

We have already made experiments on more than 120 mice and rats, 30 rabbits, and 15 guinea-pigs. We are certain of the preventive action of our vaccine, that it is free from bacteria, and that its action in animals is very rapid. The vaccine is quite harmless on man, and as the morbid phenomena of the plague in man and in animals are similar, we think that its use would be followed by the same effects in man as in animals.

The advantages to be obtained owing to the possibility of working with a substance free from bacteria, dried and dosable, is clear. If we shall be able to prove that the horse by this method gives a serum with curative properties, it will then be easy everywhere and without any danger to prepare it more quickly than by means of virulent cultures.

The cultures of the plague bacilli we owe to Professor Lukianow in the first place, and later to Professor Gabritchewski.

REFERENCES.

[1] Yersin and Roux. [2] *Annales de l'Institut Pasteur*, 1895-97. [3] *Deut. med Woch*, No. 10, 1897. [4] Hammarsten, *Zeit. f. physiol. Chemie*, 1894 Bd. XIX [5] *Deut. med. Woch.*, April 8th, 1897. [6] On the toxic qualities of this substance we must repeat here what we have already published in the *Deut. med. Woch.*, April 8th, 1897, namely, that they may vary very much with the age and virulence of the culture from which the substance is taken and mode of preparation. In two preparations we obtained a vaccine which was more poisonous than that we are now preparing, and the lethal doses given in our first publication (which referred only to two preparations) differ from those that we now give, and which we have ascertained with greater precision.

APPENDIX No. VII.

REPORT BY Dr. SIMOND

ON THE RESULTS OF THE PASTEUR INSTITUTE PLAGUE SERUM.

Translated by

Surgn.-Capt. B. B. Grayfoot, I.M.S.

To the SURGEON-GENERAL, Bombay.

Sir,—The valuable aid my colleagues of the Military Sanitary Service of India have given me in my experiments in serotherapy of plague, and more especially Drs. Grayfoot, Wilkins, Mason, Smith, Lowdell, and Robertson, place me under an obligation to report to you the results of my work since the month of June 1897. This study of the properties of anti-plague serum has been directed in two different ways :—First, the curative action ; second, prophylactic action.

Action Curative.

I have treated by subcutaneous injection of anti-plague serum more than 300 sick at Bombay, Cutch-Mandvi, Karad, and Mumbra. The mean mortality for the whole of these cases has been 58 per cent., with 42 per cent. of cures. During the same time the mean mortality which I registered in the same hospital for the cases not treated with serum reached 75 per cent., with 25 per cent. of spontaneous cures. These encouraging figures taken from all sorts of sick persons only give a very imperfect idea of the action of the serum for the following reasons.

The mortality amongst the cases not treated with serum in the hospitals where I experimented was sensibly less than the real mortality of the disease, seeing that numbers of the plague-stricken died in the city before they were discovered by the police, while almost all the convalescents were in the end discovered and brought to hospital. Thus it was that at Karad in the month of September 1897, a quarter at least of the patients admitted had already passed the fifth day of the disease and were on the way to convalescence.

2. A certain number of sick have been treated after the third or even the fourth day of the disease. Now, generally speaking, the result of the treatment at this late period is *nil*, because either the microbe has multiplied throughout the whole circulatory system, in which case death is the result after a short delay, or the natural resistance of the organism has sufficed to prevent the multiplication of the microbe in the blood and disease has spontaneously proceeded to the convalescent stage.

3. The severity of plague is very different among the various races and castes of the natives. It is for this reason that Mussulmans resist better than Hindoos, and amongst the Hindoos the resistance of the low castes is inferior to that of the higher. It is therefore absolutely necessary to establish classes among the sick subjected to treatment, and to compare results with those observed among classes of patients not treated, but under exactly the same conditions taken as controls. Proceeding in this way I have obtained the following results :—Taking a class of patients treated from the first to the fourth day, consisting indiscriminately of Mussulmans and Hindoos, the mortality has been 66 per cent., with 34 per cent. cures. At the same time and in the same hospital, the mortality of the sick admitted from the first to fourth day who have not been treated with serum has been 82 per cent., with 18 per cent. of spontaneous cures. This class consisted of 90 patients, of whom a part were treated at Cutch-Mandvi and a part at Bombay. Among the Mussulmans treated at Karad and Mumbra, and taking into consideration only those treated with serum on the first or second day of the disease, the mortality was 52 per cent., with 48 per cent. of cures. Among the control cases observed from the first to the second day of the disease, the mortality was 75 per cent., with 25 per cent. spontaneous cures.

For the Hindoos taken under the same conditions, that is to say, only taking account of patients admitted to hospital during the first two days of the disease, those treated with serum had a mortality of 68 per cent. ; and those not treated a mortality of 85 per cent., with 32 per cent. cures among those treated and 15 per cent. among those not treated with serum. The results of these three series of experiments furnish a sufficiently clear indication of the proportion of cures which ought to be attributed to the serum. This proportion of cures among those treated is constantly higher than that observed among patients taken under the same conditions as controls.

The difference in favour of the serotherapic treatment is not very great, it oscillates around 15 per cent., but that is not a quantity to be despised, if one remembers that no other treatment has produced up to date any result whatsoever. This number of cures would be greater if one eliminated from the statistics the cases of pneumonic plague. In fact, in this form of plague I have not proved any favourable result from treatment. The bubonic cases are the only ones which appear to have benefitted from treatment. In a certain number of cases, the action of the serum is manifested very clearly by a lowering of the temperature which is permanent, whereas the ordinary morning fall of the temperature, which is observed frequently in the most serious cases of plague not treated, is generally quickly followed by a very marked rise of temperature. Surgn.-Capt. Mason has collected in this regard some conclusive observations, particularly at Gaudjali, a little town in Cutch, which has had a severe epidemic of plague.

In many of the cases treated with serum and cured, I have not been able to prove a marked difference in the progress of the temperature as compared with cases not treated which recovered spontaneously. I have therefore been obliged, in order to form an estimate, to choose for each class of patients treated, a class of control patients taken from the first appearance of the disease, with identical symptoms to the patients treated with serum. This procedure which I employed at Karad and at Mumbra has shown me that the 'number of sick who benefit from the action of serum is less than I at first believed ; that it is moderate for the cases with œdematous buboes of the neck and nil for the cases with pneumonia. On the other hand, I have been able also to establish the fact, that in the common bubonic type of plague, the serum increases the natural resistance in man, as it does in animals infected with plague experimentally, and treated in the laboratory. The proportion of cures which I have obtained may appear not so good as the published mortality statistics in the hospitals, which lay claim very frequently to more than 30 per cent. of cures natural or due to different kinds of treatment.

I ought to observe that these statistics are always based on the total sick admitted into a hospital. Now plague frequently kills in 48 or 60 hours, and consequently to be true, statistics of mortality, with or without treatment, ought only to be based on the sick under observation from the first two days of the attack. Without that, one would enter therein all the convalescents admitted after several days of the disease, without counting the early deaths which most frequently take place outside of hospitals. In the hospitals, where I made my observations, the proportion of deaths for all patients admitted less than three days after the onset of plague has never been less than 74 per cent. Sometimes in the hospital reserved for low caste Hindoos it has passed 90 per cent. The variability in the success obtained with serum at different times has not solely depended on the causes mentioned above, types of disease, differences of caste and race; it has also corresponded with the difference in value of the serum I have had. Thus it is due to the superiority of the serum employed that such excellent results were obtained at Gundiali, and in a small series of

10 patients at the Khoja hospital, amongst whom there were only two deaths. In reality anti-plague serum taken from different horses and even from the same horse bled at different times does not possess at present a fixed value and curative properties. The immunisation of horses with a view to production of anti-plague serum is considered by certain doctors as a rapid and easy proceeding. Three years' experiments at the Institute Pasteur at Paris and at that at Mha-Hang, on a very large number of horses, have shown that on the contrary it is a very tedious and delicate operation. The experience gained from the treatment of the sick permit the further affirmation, that the curative value of serum is very variable, according to the remoteness of immunisations and the procedure adopted to obtain it. In this regard, chemical observations are confirmed by curative experiments on animals.

By a series of experiments made at the Institute Pasteur Dr. Roux has recently proved, that the curative power of serum does not directly correspond with its bactericide or preventive power. Thus a serum having strong preventive action, ¼ cubic centimetre of which is sufficient to immunise a mouse against the microbe of virulent plague, often fails when mice are treated with it 24 hours after inoculation with plague serum. On the other hand, a serum with half the preventive action of the above, when injected in equal doses into mice 24 hours after inoculation with virulent plague often cures; and has always delayed death a long time. These experiences have furnished us with the explanation of apparently contradictory results in men with the same serums; the one with the strongest preventive action has given insignificant results, while the other, much less strongly bactericidal, has given a proportion of successes much higher than the mean. The difference is in all probability due to the fact that to cure plague the medicine requires to have more of antitoxic action than bactericidals. For several months at the Institute Pasteur the immunisation of a certain number of horses has been directed wtih a view to obtain a serum more exclusively antitoxic and curative by processes analogous to those employed to obtain anti-diphtheritic serum.

I have the satisfaction to state that the results obtained by Surgn.-Capt. Mason, who has very kindly treated with serum a large number of sick and communicated his reports to me, agree with mine. A portion of his results have been published in a report* of Brig.-Surg-Lieut.-Col. Wilkins, who was in charge of the hospitals of Cutch-Mandvi, where the treatment was carried out.

II. *Action Prophylactic.*

My experiments in the prevention of plague by means of serum have been made on 1,160 persons in the same districts where I practised the treatment of the sick. Among these 1,160 inoculated, I only know of nine who contracted plague within 30 days following the inoculation. In one of these cases (a writer of the Karad hospital) the interval between the injection and the onset of the disease was 14 days. The patient was injected on 7th September 1897 and fell ill on 21st idem. In two other cases at Mumbra there was an interval of 16 days between the injection and the onset of plague. For the six last cases the interval has been longer. In general I have not been able to follow up the cases for longer than a month after the inoculation. It is then possible that after this period other cases of plague have occurred amongst those inoculated. The evolution of plague in the cases collected above has been according to the ordinary type, and five of these nine cases have been fatal, among which were the writer of the Karad hospital quoted above and a Hospital Assistant at Masur. One must therefore admit that, at the time the plague appeared in these cases, the immunising action of the serum had completely ceased. These results among men entirely agree with those obtained in the laboratory, and allow one to conclude that the injection of preventive serum confers with certainty an immunity for a minimum period of ten and eleven days. I have been able to convince myself that the use of serum as a preventive is scarcely a procedure applicable to the whole population of a town in order to prevent the spread of the plague. As the immunity obtained does not last very long, it would be necessary, in order that the vaccination should be efficacious, to revaccinate twice a month, which seems impracticable, and, as I have proved, is very difficult to accomplish. On the other hand the procedure is eminently practicable and easy as a precaution to people whose profession exposes them immediately to the contagion of plague; *e.g.*, the staff of a hospital. It is particularly valuable and destined to render great service in safeguarding the inhabitants of infected houses. Experience has shown how, when a person has been attacked, all the members of his family and the people living in the same house are in danger. Their vaccination with serum is a guarantee the value of which I can appreciate from many recoveries.

Among other examples, I can quote the case of an inhabitant of Masur, who, the only vaccinated person in a family of nine living together, alone survived in the infected house, the eight others having contracted plague and died in the three weeks after my journey to Masur.

If one wishes to avoid having to revaccinate persons likely to contract plague, by the fact that a member of their family has been attacked in their house, they must be made to evacuate for a certain time their dwelling, in which the virus can persist longer than the immunity conferred on them by a single vaccination. Besides, this evacuation of localities is one of the first conditions to allow of the draining, disinfection, as well as the removal of rats, who are a cause of the continuance and spread of the virus. The preventive serum obtained at the Institute Pasteur of Paris during the last months of 1897 was endowed with a bactericidal power so strong that a cubic centimetre diluted in a little water suffices to vaccinate 50 mice; that is to say, the quantity of serum, sufficient to prevent in the animal the development of a virus capable, without it, of killing it in 40 hours can be estimated at half a drop. The vaccinations are made by injecting under the skin of the flank a dose of serum consisting of 10 cubic centimetres by means of sterilisable syringe. I have often used needles of small calibre, with which the prick is scarcely perceptible to the patient.

In 21 cases I have noticed transient symptoms, such as fever, pain in the joints, and swelling of glands. I have been able to satisfy myself that these symptoms which have been of short duration, and have never obliged the persons vaccinated to remain in bed, arise from the fact that the horse which had furnished the serum had been bled too soon after an injection of serum, at a time that his blood still had feebly toxic properties.

In a single case it caused an abscess consecutively to the injection (in the case of a Mussulman at Cutch). The cause of the abscess could only be attributed to the impurities met by the needle on the skin of the patient, which were introduced into the tissues by the puncture. The injection had been made by a new assistant, who had neglected to first of all, render aseptic the skin of the part to be inoculated. This is a precaution which one ought never to forget. In all the other cases after the injection prophylactic no other symptom or indisposition worthy of note ever occurred. From the first to the fourth day frequently for some hours a feeling of fatigue supervened but that was an absolutely harmless result which did not prevent the patient from attending to his ordinary duties. In conclusion, I must express to you my gratitude for the cordial welcome which I have always received from the officers serving under your orders and for the facilities they have given me in the accomplishment of the mission of study entrusted to me by his Excellency the Minister for the Colonies and by the Institute Pasteur.

I beg to remain, etc.,
L. SIMOND,
Director of the Pasteur Institute at Saigon,
Doctor of the First Class of the Military Sanitary Corps for the Colonies.

BOMBAY;
2nd February 1898.

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* See Appendix No. VIII in this Volume.

APPENDIX No. VIII.

NOTES ON PLAGUE.

COMPILED FROM PERSONAL OBSERVATION OF OVER 1,200 CASES IN HOSPITAL AND A VERY LARGE NUMBER OUTSIDE,

BY

CAPTAIN H. DEMPSTER MASON, A.M.S.

PLAGUE, *La Peste* (BLACK-DEATH).

From a fair amount of evidence obtainable from different sources, it is highly probable that the earliest manifestation of this disease occurred at the end of February 1897; that the patient had been brought by sea from the infected neighbouring port of Karachi, and, owing to the feeble attempts at quarantine, was permitted to be nursed in the segregation hut by relatives living in the village of Muska. Naturally enough, plague then broke out in the house of the relatives, whence it spread to the town of Mandvi and all the villages in the immediate vicinity.

Having once established itself, the disease found every condition favourable, not only for its existence, but for its rapid development in the most virulent form.

Local conditions.

The conditions chiefly affecting its propagation are: a warm and humid atmosphere, the people living in marshy soil on the sea-coast and creeks; low, badly-ventilated and over-crowded houses; great accumulation of putrefying animal and vegetable matter in the vicinity of the dwellings; the most revolting filthiness in personal habits, and the whole city little better than one large latrine, in such an insanitary state that it requires to be seen to be believed. This condition appears, on inquiry, to be such as might have been anticipated where no organised system of scavenging had existed for centuries.

Contagious nature of the disease.

The relations between the sick and healthy undoubtedly exercise a most important influence on the propagation and extension of the disease. In the absence of quarantine, perfectly free intercourse existed between the healthy and the sick, and it has been noticed that persons living in the same house with the sick are peculiarly liable to suffer, whilst those brought only into occasional contact are not so likely to become infected. This observation has been well illustrated in the various hospitals where there has been a large staff employed in doctoring, nursing, and other duties of an occasional character. Out of this number there have been two cases of plague—one an orderly and the other an ayah. There is no doubt that the disease is "caught" from the sick by the healthy brought into association with them; in other words, it is contagious: this expresses the wider meaning of the term which includes the process direct, or intermediate, of conveying its bacillus from the sick to the healthy.

There are several means of conveyance:—

1. By the air, producing the very common and fatal form of *primary plague-pneumonia.*
2. By the food or drink (*acute plague-dysentery*).
3. By the skin.

I am inclined to think that the latter method is far commoner than is generally supposed, especially amongst the cases affected with buboes. Out of the following 260 cases of patients dying with buboes, it has been found that there were—

No buboes	94
Right inguinal	60
Left "	58
Right axillary	19
Left "	11
Submaxillary	7
Cervical	1
Supratrochlear	1
Parotid	1
Multiple	8

From the above it will be seen that by far the largest number of buboes affected the groin. The explanation of this appears to be that the large majority of Cutchees wear no protection to the feet, and it is perfectly easy to understand that, under these circumstances, ever so slight an abrasion of the superficial epithelium (an unavoidable occurrence in a barefooted race) would provide a mode of entrance to the bacillus followed by an inflammatory condition of the nearest glands.

The same principle applies equally to other parts of the body. The next largest number to the inguinal are the axillary, the right axillary nearly double the left, because the right hand is not only used more than the left, but is almost exclusively used in eating.

The submaxillary becomes infected by the entrance of the bacillus through a carious tooth, the supratrochlear from the hand, and the parotid through Stenson's Duct. The cases fairly illustrate the frequency of direct inoculation, which in the present state of our knowledge should come under the old head of contagion.

Of other means of indirect contagion there appears to be some evidence of the transmission of the disease by the agency of clothes and bedding which have been used by the sick, but the main point in connection with the liability of the healthy to contract the disease seems to be dependent on the intimacy and regularity of communication with the sick.

Seasonal changes.

Both the local conditions and the conditions affecting the healthy and sick appear to be modified by seasonal changes; commencing in the cool weather of February, attaining its height in May, the epidemic commenced to decline with the decline of the hot season in June.

Incubation.

It seems next to impossible to furnish any precise data with respect to the actual period of incubation, but there has been sufficient evidence to indicate that in the large majority of cases it is short. Assuming the theory of direct inoculation to be correct, it is probable that the period varies from a few hours to one or two days. By other methods it may extend to a maximum of eight days, and the average might be set down at five.

Symptoms.

Perhaps the most striking point in connection with the symptoms of the disease is that the onset and progress differ enormously in different cases. Most commonly after a period of lassitude, headache, aching in the limbs and loins the fever commences, and either concurrently with this or from the second to the fourth day, tenderness followed by buboes in the groins, axillæ, or angles of the jaws. The febrile condition is usually acute in the early stages, often accompanied by severe headache, and in the worst cases by delirium and stupor. In some of these latter the whole toxic effect of the disease seems to localise itself in the central nervous system, producing the gravest symptoms—the suffused conjunctivæ, the hesitating drunken speech, the inability to comprehend or answer questions, the feeble pulse, the extreme prostration—all marked indications of the severity of the attack. In less grave conditions the tongue is white and thickly coated, the teeth and gums covered with sordes, and the thirst intense. The swelling of the glands increases and is accompanied by tenderness, sometimes followed by acute pain. In several cases a condition has been noted in which no gland could be detected, but a thick puffy œdematous condition of the skin over the situation of the gland in the axillæ especially, which rapidly spreads to the adjoining parts, in one case extending on the right side over the whole of the chest as low as the last rib, across the front of the chest to the tip of the left shoulder, and over the right shoulder into the neck as high as the lower jaw. All these cases proved rapidly fatal. The pulse runs quickly up to 120 to 130. The temperature varies

Phlegmonous condition of the skin.

from 102° in the mild, to 107° in the severest form. The end of the fever is commonly marked by a sudden fall of temperature often as low as 97° or 96°F. In the early stages nausea and bilious vomiting are very common. The urine commonly contains albumen, and there have been several cases of retention, and two of complete suppression. In the later stages the fæces are passed involuntarily.

Local signs.

Of the local signs the appearance of buboes, or rather tenderness, not infrequently precedes the symptoms of the general disturbance. In some cases they are first observed within twelve hours after the fever has set in, in other and more numerous cases they show themselves on the second, third and fourth day of the attack. The enlarged glands forming buboes are rarely numerous (*vide* Statistics), and of a group only one is, as a rule, enlarged, attaining the size of a cocoanut, whilst others are but little enlarged. Suppuration rarely occurs in fatal cases, the toxic poison seldom admitting of sufficient time to reach that stage.

Petechiæ distributed generally over the body are often observed usually preceding a fatal issue.

Necrosis of skin.

Pustules commencing as sanguineous bubo varying in size from a nut to a hen's egg followed by suppuration and necrosis of skin.

Physiognomy.

Plague has a special physiognomy, having nothing in common with other diseases. The eyes are suffused and retreated within the orbits, the aspect is haggard and expresses apathy, the patient looks stupefied as if intoxicated and does not readily answer questions, but one is ***not*** struck with the gravity of the condition or the danger to life. Even the worst cases are apt to deceive the inexperienced, and make him believe the case to be free from danger, when, in reality, it has only a few hours to live. How many cases can one call to mind of fine robust patients in this condition in the morning found dead at the evening visit. There is still another class of patient met with chiefly at the beginning of the epidemic, but also in the middle and at the end, who are suddenly stricken down with illness and die in a few hours, without any of the external characteristic manifestations of the disease, the amount of the toxin produced by the bacilli being so great that the central nervous system is completely overwhelmed and its function arrested. It is in cases intermediate between the latter and an attack of ordinary intensity that the symptom of aphasia is so commonly observed. Curiously, the histories of these cases have been precisely the same: high temperature; the attack chiefly localised in the nervous system; delirium lasting a variable time usually short, followed by sometimes complete loss of power to produce any sound (aphonia), or more often, whilst consciousness remains intact, there is complete loss of power to convert thoughts into words. Fortunately the majority of these cases recover the lost power rapidly, the thickened disjointed guttural attempt at speech indicating the first favourable sign. In association with this condition in several cases there has been marked ataxia shown by the feeble grip, the inability to perform purposive co-ordinate movements either with the hands or arms or legs, this also clears up rapidly as recovery advances. During the later stages of the disease there has been one well-marked case of right hemiplegia. In these latter cases buboes have not been a conspicuous symptom. Lastly, after the epidemic had reached its height, pulmonary disturbance has been the most predominating and fatal feature. It takes the form of catarrhal pneumonia, and may be either primary or secondary; the primary form and the attack localised in the central nervous system have been by far the most fatal symptoms developed. Not a single case of primary pneumonia has recovered, and so far the same may be said of the secondary form.

Pulmonary.

Conjunctivitis.

Conjunctivitis has also been a frequent symptom, starting as a simple suffusion of the conjunctivæ followed by corneal ulcers, panophthalmitis, and often leading to destruction of one or both eyes.

Complications.

Plague is a disease marked by a very protracted convalescence, during this period complications of the most varied description are likely to develop.

The most frequent are—

(*a*) Sloughing of glands entire, with the skin over them.

(*b*) Multiple synovitis, sometimes leading to suppuration. This condition in the early stages has many symptoms in common with acute rheumatism, later it becomes localised in the joints, chiefly wrists, ankles, knees and elbows, and may be followed by suppuration. In one case the left knee-joint alone was affected.

(*c*) Secondary pneumonia.

(*d*) Conjunctivitis, corneal ulcers, panophthalmitis.

(*e*) Pareses and paralysis, aphonia, aphasia, hemiplegia, imbecility.

(*f*) Thrombosis.

(*g*) Retention of urine.

(*h*) Suppression.

(*i*) Pyæmia.

Diagnosis.

There is apparently no other idiopathic fever attacking a large number of people at the same time, which is characterised by glandular swellings and by those grave symptoms of the nervous blood and biliary systems which show themselves in an attack of plague. Plague concurrent with malaria. Concurrent attacks of plague and malaria [as shown by the discovery of Laveran's body (Amœboid)] have been noted in which the malaria confers a distinct periodicity on the temperature of plague.

Prognosis.

All cases complicated with (1) primary pneumonia, (2) extensive œdematous condition of skin over seat of buboes, (3) all cases in which the attack centralises itself from the first in the nervous system, end fatally, whilst rapid suppuration of buboes is looked upon as a favourable symptom.

Of five cases of abortion from plague not one has recovered.

The prognosis is better in children than men and in men than women; of 260 deaths in the Brahmapuri Hospital (Hindus) there have been—

Males	89
Females	146
Children (under 10) . . .	25

whilst from deaths, 3,516, from all hospitals, there have been—

Males	1,226
Females	1,727
Children	563

The high rate of mortality among females may be partially accounted for, *first*, by the fact that large numbers of the Hindoo men inhabiting the city are merchants and extensive travellers by sea; *second*, a much larger number, with the chivalry common to the native mind, on the outbreak of the epidemic, fled the city, panic-stricken, leaving their wives, children, and belongings to forage for themselves. The healthy and robust appear not only to prove to contract the disease, but to suffer from the most virulent forms and die in as great a proportion as those of weaklier frame and weaker constitution.

Mortality.

The mortality appears to have differed among the various castes and at different phases of the epidemic.

Of the first 100 recorded cases in the Brahmapuri Hospital (Hindu) the mortality was . . .	90	per cent.
Of 100 cases recorded from the same source a month later, the mortality was	83	„
Amongst the Borah community from 7th April to 11th June (Hajira Hospital), the mortality was .	45	„
General Muhammadan Hospital .	61	„
Khatri and Muhammadan Hospital .	36	„
Khoja Hospital	13	„

From the above statistics, it will be seen that the Hindus suffered by far the worst; but considering the ghastly conditions of their existence, the terrible overcrowding in low badly-built, badly-ventilated and worse-lighted houses, the total absence of drainage, and the most degrading personal filth, the only marvel is that the whole population has not been annihilated.

That the mortality has been seriously aggravated by the lamentable ignorance and obstinacy of all castes in refusing to bring their sick early to hospital, no one can for a moment doubt; large numbers of cases have been admitted moribund, or have died within a few hours. Many have been admitted in the most loathsome condition, one poor wretch having suffered such frightful neglect that the whole of an enormous cervical bubo extending from the left ear to the sterno-clavicular joint was found on admission to be filled with living maggots. Children brought in with perforated corneal ulcers, men with enormous sloughing glands, and all the horrors of the later stages, indicated their set resolution that no patient, however ill, should be brought to hospital until his condition was thought by his relatives to be hopeless if kept at home.

The same cannot be said of the Borah community, for, on the outbreak of the epidemic, the whole sect was taken in hand by the headman and removed into segregation huts outside the city and there kept in isolation. This and the fact that 571 out of a community of 1,500 were inoculated with Yersin's preventive serum undoubtedly account for the low rate of mortality.

To the Khatri and Khoja castes, both numerically small, to a large extent the same remarks apply.

The mortality also varies considerably with the day of the disease on which the patient is admitted.

Of 100 non-inoculated cases from the Brahmapuri Hospital, from May 25th to June 2nd admitted—

First day	82 per cent. died.
Second „	66 „ „
Third „	95 „ „

Thus the third day is by far the most fatal, and this experience has been endorsed at all the other hospitals.

The general Muhammadan Hospital received patients from the city and the village of Salaya where the sea-faring community exists, under much the same conditions as the Hindus in the city, except that there is less overcrowding, more light and air.

Treatment—

(*a*) *Preventive.*

(*b*) *Curative.*

(*a*) *Preventive* methods consist chiefly in removal of the conditions which favour the development of the disease and, having become established, the limitation of its spread.

The conditions favourable to the development of plague have already been enumerated.

With regard to the limitation of its spread, the chief considerations are—

(*a*) *Isolation* of the sick under the best circumstances.

(*b*) *Disinfection* of all articles of clothing or bedding used by the patient and of the house in which he has lived.

(*c*) *Preventive inoculation* of serum antipesteux prepared by the Pasteur Institute.

On account of the brief period of immunity conveyed by the usual dose of 10 cc., it is extremely difficult to prove the value of this method of treatment.

It has *not* been found possible to inoculate whole communities (every ten days). The communities object, in which case it is not accurate to ascribe the absence of plague to the immunising effect of the serum; nevertheless, it is an extraordinary fact that, out of 721 persons who have been inoculated once only, up to the present not a single case of plague has developed. These cases have all been registered and are composed of different castes living in different places.

Men of Borah community	380
Children „ „	191
Men, women and children of Muska village	110
Men, women and children of Bada village (16 miles from Mandvi)	40

It also seems clear that immunisation conveyed by the preventive serum becomes rapidly less from tenth day to the twentieth day, when it may be said to be exhausted. Sepoy Jayanak Tulnak, who died from plague, had been inoculated 20 days previously to the attack.

(*b*) *Curative* (*a*) General, (*b*) Special.

As no specific has hitherto been discovered for the cure of plague, the treatment resolves itself into the carrying out of the general principles of medicine as applied to the treatment of symptoms arising in the course of the disease.

The stimulant method and the administration of liq. hydrargyri perchloridæ have both been given the fullest trial and both have proved equally inefficacious in either controlling or checking the disease.

In order to arrive at some definite conclusion as to the value of the various methods of treatment, and especially to compare the results of the general, in contrast to the special, treatment by inoculation of serum antipesteux, I have collected 100 cases which were admitted to hospital between the first and the fourth day of the disease, and treated by the usual methods, and I had hoped to have been able to collect 100 cases of patients treated by inoculation, admitted under exactly the same conditions as those of the first hundred, but the lack of serum at the critical time has rendered this difficult to accomplish.

Appended is a list of 30 cases inoculated, and nearly 100 cases non-inoculated.

The mortality in the former is 60 per cent., in the latter 83 per cent., that is to say, a saving of life of 23 per cent., and, although this is not as good a result as I had at one time anticipated, it is sufficient to indicate the right path and to act as a further stimulus in perfecting the only means we have at present of even influencing one of the direst diseases that ever afflicted humanity.

With regard to the action of the serum itself by reason of the irregularity of the temperature curves in plague, it is very difficult to determine exactly the modification which the administration of serum produces on these curves.

It is absolutely certain that in ordinary cases the temperature falls under the action of the first injection, that is to say, in the first 24 hours, and it is equally certain in many cases that it never re-ascends.

This fall is obtained whatever the day of the disease on which the treatment is commenced, unless the patient is moribund.

The fall in temperature is generally temporary even in those about to recover.

The most characteristic actions of serum (in cases of ordinary gravity) inoculated in the earliest stages of the disease are: (*a*) fall in temperature, (*b*) amelioration of the general condition, (*c*) diminution of stupor, (*d*) improvement in prostration.

The improvement in the general condition like the fall in temperature is in the majority of the gravest cases transitory, the symptoms again become serious, and the disease appears to run its course as if the serum had not been given.

The alteration brought about by the serum exercises an influence which is prolonged over the temporary improvement noticeable after the inoculation.

In cases treated early from the first to the second day, the progress of the disease and the intensity of the symptoms are diminished.

When the first re-action of the serum is exhausted, the fever returns with less virulence, and there is generally less stupor than before the commencement of the treatment.

In cases which appear certain to die, the course of the disease seems to be stayed, and, even if recovery does not take place, it nevertheless provides a most powerful resistance to the disease and one which may last a considerable time.

The decided action of the serum is proved in all cases where the patient does not die within 24 hours (which is an indispensable condition, in order that the serum may have time to act). I therefore submit that, if the treatment by serum is ineffective in a certain number of cases, it has an enormous power over those cases where the toxin poisoning is not the gravest and where the disease does *not* run its most rapid course. In the majority of these cases we are bound to admit that the recovery is due to the serum.

Cases of Plague inoculated at Brahmapuri Hospital admitted between 1st and 4th day of the Disease.

Name.	Sex.	Age.	Admitted to Hospital.	How long ill when injected.	Total quantity injected.	Result.	Bubo.	Remarks.
			1897.					
Nursey Jiva	Male	9	30th May	4 days	90 c. c.	Discharged cured	Parotid L. G. L. C.	
Jayanak	"	35	"	"	105 c. c.	Died 4th June 1897	Right axilla.	
Ramanbai	Female	15	1st June	1 day	120 c. c.	Died 3rd June 1897	Do.	
Sirjee	Male	8	"	2 days	150 c. c.	Died 11th June 1897	Right inguinal and femoral.	
Godavribai	Female	32	2nd June	"	220 c. c.	Discharged cured, 11th June 1897	Right groin. Pustule left foot.	
Bhababai	"	13	"	4 days	190 c. c.	Died 6th June 1897	Left femoral. Right and left feet swollen and right and left cervical.	
Hirji	Male	8	"	1 day	50 c. c.	Died 4th June 1897	Left axilla.	
Matoobai	Female	40	3rd June	2 days	140 c. c.	Died 5th June 1897	Left femoral.	
Rattonbai	"	45	4th June	"	170 c. c.	Died 11th June 1897	Right groin.	
Rattonbai	"	29	"	"	200 c. c.	Died 23rd June 1897	Left femoral. Pneumonia.	
Godavaribai	"	30	"	1 day	160 c. c.	Discharged cured, 11th June 1897	Left groin.	
Kankoobai	"	20	"	"	100 c. c.	Discharged cured	*Nil.*	
Mambai	"	40	"	"	140 c. c.	Died 9th June 1897	Left femoral.	
Karoo	Male	40	"		230 c. c.	Died 8th June 1897	*Nil.*	
Dhanaswer	"	45	5th June	2 days	170 c. c.	Died 9th June 1897	Right inguinal. Suppression of urine.	
Sambai	Female	28	6th June	"	230 c. c.	Died 13th June 1897	Right groin.	
Janki	"	25	7th June	3 days	140 c. c.	Died 11th June 1897	Left groin.	
Bambabai	"	60	9th June	"	120 c. c.	Died 12th June 1897	Right axilla.	
Naran Valji	Male	45	"	1 day	200 c. c.	Discharged, 23rd June 1897	Pneumonia.	
Rattanbai	Female	21	11th June	3 days	40 c. c.	Died 14th June 1897	Right groin.	
Rasambai	"	30	15th June	"	90 c. c.	Discharged	*Nil.*	
Jayantibai	"	40	20th June	4 days	110 c. c.	Discharged cured	Right groin.	
Padmabai	"	10	"	3 days	100 c. c.	Do.	Do.	
Jane Pereira	"	33	"	1 day	150 c. c.	Died 23rd June 1897	Do.	
Koonabai	"	45	22nd June	2 days	120 c. c.	Died 24th June 1897	Left submaxillary.	
Sumar	Male	11	9th June	4 days	100 c. c.	Discharged cured, 19th June 1897	Left groin.	
Aboo	"	55	23rd June	1 day	150 c. c.	Died 28th June 1897	Right groin.	
Samji	"	50	"	"	90 c. c.	Discharged cured	Left groin.	
Hazarabai	Female	18	19th June	2 days	110 c. c.	Do.	Do.	
Havabai	"	17	"	"	110 c. c.	Do.	Do.	

Cases admitted between 1st and 4th days (4 after or unknown).

No.	Name.	Sex.	Age.	How long ill.	Admitted to Hospital.	Buboes.	Result.
					1897.		
1	Mohanji	Male	30	2 days	25th May	*Nil*	Died.
2	Lalji	„	27	Very old case	„	„	„
3	Cooverji	„	35	4 days	„	Left groin	„
4	Khimji	„	50	2 „	„	Right groin	„
5	Shambai	Female	18	2 „	„	*Nil*	„
6	Panabai	„	„	Not known	„	„	„
7	Vishnubai	„	50	3 days	„	„	„
8	Moonjibai	„	30	*Nil*	„	„	„
9	Premjibai	„	18	„	„	„	„
10	Ratanshi	Male	20	2 days	„	„	„
11	Soonderbai	Female	70	2 „	„	„	„
12	Dhanbai	„	32	2 „	„	Left axilla	„
13	Nanbai	„	30	3 „	26th May	„ groin	„
14	Dharamshi	Male	70	3 „	„	*Nil*	„
15	Sambai	Female	35	4 „	„	„	„
16	Dahya	Male	25	3 „	„	„	„
17	Harjiwan	„	55	3 „	„	„	„
18	Pritambai	Female	60	3 „	„	„	„
19	Kashibai	„	23	2 „	„	Left groin	Discharged.
20	Gangabai	„	40	3 „	„	„ axilla	Died.
21	Joshi Manji	Male	50	2 „	„	„ „	„
22	Gombai	Female	10	2 „	„	„ parotid	Discharged.
23	Poonja	Male	85	3 „	„	...	Died.
24	Sungsi	„	20	2 „	„	Left axilla	„
25	Velji	„	80	4 „	„	Right „	„
26	Lakanbai	Female	32	3 „	„	...	„
27	Lalji	Male	19	3 „	„	...	Discharged.
28	Govan Khimji	„	60	2 „	27th May	Left groin, small	Died.
29	Meghji Premji	„	30	2 „	„	Right axilla	„
30	Lohsajbai	Female	16	3 „	„	*Nil*	„
31	Velbai Rambai	„	13	2 „	„	Right axilla	Discharged.
32	Vhalibai	„	14	2 „	„	„ parotid	Died.
33	Mithoobai	„	30	2 „	„	*Nil*	„
34	Pragji	Male	10	4 „	„	Right groin	„
35	Mooli	Female	15	4 „	„	„ „	Discharged.
36	Meethi	„	20	4 „	„	„ axilla	Died.
37	Velibai	„	38	1 day	„	„ groin	Discharged.
38	Gomtibai	„	40	2 days	28th May	„ „	Died.
39	Vasanji	Male	80	2 „	„	„ axilla	„
40	Manekbai	Female	25	2 „	„	„ groin	„

Cases admitted between 1st and 4th days (4 after or unknown)—contd.

No.	Name.	Sex.	Age.	How long ill.	Admitted to Hospital.	Buboes.	Result.
					1897.		
41	Ramanbai	Female	30	2 days	28th May	Right groin	Died.
42	Hiroobai	,,	6	2 ,,	,,	,, ,,	,,
43	Nanji	Male	6	2 ,,	,,	,, ,,	,,
44	Dharsi	,,	14	6 ,,	,,	Pneumonia	,,
45	Manbai	Female	4	2 ,,	,,	Right groin	,,
46	Velji	Male	10	3 ,,	,,	...	,,
47	Panoo	,,	25	4 ,,	,,	...	,,
48	Jetha	,,	35	2 ,,	,,	...	,,
49	Virbai	Female	16	1 day	,,	Left groin	,,
50	Gomatibai	,,	50	1 ,,	,,	*Nil*	,,
51	Loolibai	,,	35	1 ,,	,,	Right groin	Discharged.
52	Naran	Male	45	2 days	,,	*Nil*	Died.
53	Nathibai	Female	30	2 ,,	,,	Right axilla	,,
54	Charupanbai	,,	25	4 ,,	,,	,, inguinal	Discharged.
55	Khimji	Male	60	4 ,,	,,	,, groin	Died.
56	Hansibai	Female	18	6 ,,	,,	...	,,
57	Kalianji	Male	21	3 ,,	,,	Left groin	,,
58	Panchibai	Female	12	1 day	,,	,, ,,	,,
59	Gangabai	,,	25	2 days	,,	Right groin	Discharged.
60	Kanji	Male	10	1 day	29th May	,, axilla	Died.
61	Pralimanbai	Female	5	4 days	,,	,, groin	,,
62	Ramdass	Male	35	1 day	,,	Maxillary	,,
63	Parvatibai	Female	30	1 ,,	,,	Left groin	,,
64	Kanji	Male	13	1 ,,	,,	Right ,,	,,
65	Wandubai	Female	20	2 days	,,	Left ,,	,,
66	Manekbai	,,	8	4 ,,	,,	Right ,,	,,
67	Champsi	Male	22	3 ,,	,,	,, ,,	,,
68	Devkorebai	Female	15	2 ,,	,,	Left ,,	,,
69	Dhyanbai	,,	28	3 ,,	,,	...	,,
70	Virji	Male	9	3 ,,	,,	Right cervical	,,
71	Manjibai	Female	20	1 day	,,	Left groin	,,
72	Kalidas	Male	35	2 days	30th May	...	,,
73	Amratbai	Female	50	4 ,,	,,	Right and left groins.	Discharged.
74	Gangabai	,,	...	1 day	,,	*Nil*	Died.
75	Ratanbai	,,	42	2 days	,,	...	,,
76	Cooverbai	,,	20	1 day	,,	Left groin	,,
77	Motibai	,,	7	4 days	,,	Tenderness, left groin.	,,
78	Ladibai	,,	40	2 ,,	,,	Left groin	Discharged.
79	Manekbai	,,	48	3 ,,	,,	,, axilla	Died.

Cases admitted between 1st and 4th days (4 after or unknown)—concld.

No.	Name.	Sex.	Age.	How long ill.	Admitted to Hospital.	Buboes.	Result.
					1897.		
80	Ramji	Male	41	2 days	30th May	Left groin	Discharged.
81	Govindji	„	40	1 day	„	„ „	Died.
82	Samji	„	40	2 days	31st May	„ „	„
83	Moolibai	Female	50	2 „	„	*Nil*	„
84	Hansraj	Male	25	1 day	„	Left groin	„
85	Lakhmibai	Female	14	2 days	„	„ axilla	„
86	Motio	Male	6	2 „	„	„ cervical	Discharged.
87	Ramji	„	8	1 day	„	„ inguinal	„
88	Sivji	„	18	1 „	„	„ „	Died.
89	Motibai	Female	35	3 days	„	„ groin	„
90	Lilbai	„	20	1 day	„	Right „	„
91	Panbai	„	40	3 days	1st June	...	„
92	Kara	Male	20	3 „	„	...	„
93	Kamabai	Female	70	2 „	„	Right cervical	Discharged.
94	Hirabai	„	25	3 „	„	„ „	Died.
95	Hadhubai	„	35	2 „	2nd June	„ groin	„

APPENDIX

Notes on the bacteriological examination of

						DIRECT EXPERIMENT.				
						RESULT OF THE EXAMINATION OF THE SAMPLE AS COLLECTED.				
Serial number.	Descriptive number.	Nature of sample.	By whom collected.	Date when collected.	Date when examined.	Direct microscopic.	By cultivation on agar.	Result of inoculation into rats.	Period after inoculation.	Plague germs found or not.
1	Bombay 1	Scrapings from floor.	Dr. Gibson	22nd March 1898.	22nd March 1898.	Various organisms seen.	Plague not found.	Rat survived.	...	Not found
2	" 2	Floor scraping	Mr. Stevens	8th September 1898.	11th September 1898.	Ditto	Ditto	Ditto	...	Ditto
3	" 3	Scraping from floor.	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto	...	Ditto
4	Hyderabad 1	Ditto	Col. Lawrie.	...	13th September 1898.	Ditto	Ditto	Ditto	...	Ditto
5	Dharwar 1	Earth from cook-and bath-rooms.	Miss Corthorn, M.B.	15th September 1898.	22nd September 1898.	Short bacilli cocci and diplococci.	Ditto	Ditto	...	Ditto
6	" 2	Mud from cook-and bath-rooms.	Ditto	Ditto	Ditto	Ditto	Ditto	Rat died	60 hours	Ditto
7	" 3	Scraping from where corpse was lying.	Ditto	16th September 1898.	23rd September 1898.	Cocci and diplococci.	Ditto	Rat survived.	...	Ditto
8	" 4	Ditto	Ditto	15th September 1898.	Ditto	Bacilli and cocci, etc.	Ditto	Ditto	...	Ditto
9	" 5	Soiled bit of cloth.	Ditto	Ditto	26th September 1898.	None seen	Ditto	Rat died	29days. E	Ditto
10	" 6	Ditto. F	Ditto	Ditto	Ditto	Innumerable forms seen.	Overgrown.	Rat survived.	...	Ditto
11	Bombay 4	Scraping from floor.	Dr. Gibson	2nd November 1898.	2nd November 1898.	Cocci and diplococci, few bacilli.	Plague not found.	Ditto	...	Ditto
12	" 5	Ditto	Ditto	Ditto	Ditto	Many organisms seen.	Ditto	Ditto	...	Ditto
13	Hyderabad 2	Ditto	Col. Lawrie	...	16th November 1898.	Few organisms seen.	Overgrown	Ditto	...	Ditto
14	" 3	Ditto	Ditto	...	Ditto	Ditto	Plague not found.	Ditto	...	Ditto
15	" 4	Ditto	Ditto	...	17th November 1898.	Ditto	Ditto	Ditto	...	Ditto
16	" 5	Ditto	Ditto	...	Ditto	Micro-organisms fairly plentiful.	Ditto	Ditto	...	Ditto
17	" 6	Ditto	Ditto	...	Ditto	Ditto	Ditto	Ditto	...	Ditto
18	" 7	Ditto	Ditto	...	Ditto	Sarcina and cocci seen.	Ditto	Ditto	...	Ditto
19	Bombay 6	Ditto	Dr. Gibson	7th February 1899.	8th February 1899.	...	Overgrown	Rat died. O	90 hours	Ditto
20	" 7	Soil from various rat holes.	Ditto	Ditto	Ditto	...	Ditto	Died. O	7 days	Ditto
21	" 8	Soil from floor	Ditto	Ditto	Ditto	...	Ditto	Died. O	...	Ditto

No. IX.

suspected substances by Dr. Gibson.

CONTROL EXPERIMENT.					
RESULT OF THE EXAMINATION OF THE SAMPLE AFTER THE ADDITION OF A MINUTE TRACE OF A PLAGUE CULTURE.					Age of plague culture added.
Direct microscopic.	By cultivation on agar.	Result of inoculation into rats.	Period after inoculation.	Plague germs isolated or not.	
...	Plague not isolated.	Died	72 hours	Plague isolated	2 days
Many germs seen.	Ditto	,,	65 ,,	Ditto	2 ,,
Ditto	Plague isolated	,,	72 ,,	Ditto. A	2 ,,
Ditto	Plague not isolated.	Survived	...	Plague not isolated.	2 ,,
Ditto	Plague isolated	Died	60 hours	Ditto. B	3 ,,
Ditto	Plague not isolated.	,,	110 ,,	Plague isolated	3 ,,
Ditto	Ditto	,,	20 ,,	Plague not isolated. C	2 ,,
Ditto	Ditto	,,	65 ,,	Plague isolated. D	2 ,,
Plague like bacilli seen.	Ditto	Survived	...	Plague not isolated.	2 ,,
Innumerable forms seen.	Ditto	Died	5 days	Ditto. G	2 ,,
Cocci and diplococci, etc.	Ditto	,,	65 hours	Plague isolated. H	1 day
Many organisms seen.	Plague isolated	,,	65 ,,	Ditto. I	1 ,,
Few germs seen	Plague not isolated.	,,	110 ,,	Ditto. J	4 days
Ditto	Ditto	,,	110 ,,	Plague not isolated. K	4 ,,
Cocci and bacilli seen.	Ditto	,,	7 days	Plague isolated. L	1 day
Ditto	Ditto	,,	65 hours	Ditto	1 ,,
Ditto	Ditto	,,	80 ,,	Ditto. M	1 ,,
Ditto	Ditto	,,	80 ,,	Plague not isolated. N	1 ,,
...	Ditto	,,	65 ,,	Ditto. P	5 days
...	Ditto	,,	5½ days	Plague isolated	5 ,,

REMARKS.

A. In pure culture.

B. Rat much putrified when examined.

C. Rat died probably before plague had time to develope.

D. In pure culture.

E. Note long period between inoculation and death, latter probably not due to former.

F. Sample soiled with excrement, very putrid smell.

G. Tubes cultivated from organs hopelessly overgrown.

H. In pure culture.

I. In pure culture.

J. In pure culture.

K. Tubes cultivated from organs overgrown with putrefactive organism.

L. In pure culture.

M. In pure culture.

N. Putrefaction advanced when rat examined.

O. Larger quantity, circa 2 grammes of soil, used in making suspension.

P. These rats kept overnight in ice after death, as they could not be examined on day of death.

SUMMARY.

DIRECT EXPERIMENTS.

Twenty-one rats inoculated, 5 died, 25 per cent. See note O. No plague obtained in any of these, or by cultivation of the samples.

CONTROL EXPERIMENTS.

Twenty-one rats inoculated, 19 died, 90 per cent. Plague isolated in 13 cases, 62 per cent. of total or in 68 per cent. of the rats dying. In six cases plague was not recovered from the dead rats. In five of these the rats were more or less putrefied when examined. In four cases the plague organism was recovered by cultivation of the sample.

APPENDIX No. IX—*continued.*

Plague history of houses in Bombay from which samples were collected for bacteriological examination.

No. of Sample.	Street.	No. of house.	By whom collected	Date of collection.	Date of last case.	Cases in 1st epidemic, July 1896-97.	Cases in 2nd epidemic, July 1897-98.	Cases in 3rd epidemic, July 1898.	REMARKS.
Bombay 1 .	Fifth Street, Kamatipura.	24	Dr. Gibson .	22nd March 1898.	22nd March 1898.	None . . .	Three cases, 22nd March 1898.	None . . .	No disinfection carried out immediately previous to collection of sample, *i.e.*, since last case occurred.
" 2 .	Hamal Street . .	61	Mr. Stevens .	8th September 1898.	8th September 1898.	Not known . .	8th September 1898 .	Not known . .	Ditto ditto.
" 3 .	Hamal Street .	62	Ditto .	Ditto .	Not known .	Ditto . .	Not known . .	Ditto . .	Ditto ditto.
" 4 .	Second Street, Kamatipura.	118	Dr. Gibson .	2nd November 1898.	1st November 1898.	None . . .	One case, 8th March 1898.	Two cases, 1st November 1898.	Ditto ditto.
" 5 .	Fourteenth Street, Kamatipura.	64	Ditto .	Ditto .	Ditto .	Four cases, date not known.	One case, date not known	One case, 1st November 1898.	Twelve cases in house next door to this one. No disinfection between last case and collection of sample.
" 6 .	Sixth Street, Kamatipura.	35	Ditto .	7th February 1899.	6th February 1899.	One case, 29th March 1897.	...	One case, 6th February 1899	Ditto ditto.
" 7 .	Sixth Street, Kamatipura.	2	Ditto .	Ditto .	29th January 1899.	Six cases. Three dates not known. 23rd January 1897 10th January 1897. 4th January 1897.	Four cases. 21st January 1898. 28th January 1898. 16th February 1898. 13th March 1898.	Three cases. 15th January 1899. 16th January 1899. 29th January 1899.	This house had been disinfected on 30th January 1899. Sample was collected from the mouths of the very numerous rat-holes. The regular recurrence of cases in this house is striking.
" 8 .	Baptist road, Kamatipura.	24	Ditto .	Ditto .	7th February 1899.	None . . .	None . . .	One case, 7th February 1899.	This house is a large weavers' chawl, and in one corner of the ground floor patient had his loom, and lived. He was removed suffering from cervical bubonic plague (? inhalation of dust), ½ hour before sample was taken. No disinfection between last case and collection of sample.

Note.—Houses from which samples were taken, were such as had had a plague case in them recently, within 24 hours in most cases. The sample was collected in increments from various points of the room in which the case had occurred, attention being paid especially to the spot where the corpse was lying or had lain, to damp spots in the room, to rat holes, etc. The floor was thoroughly scratched with a stout metal spatula and the fragments so detached were transferred to wide mouthed, corked, sterilized bottles. Each sample thus consisted of 5 or 6 portions, and before examination it was thoroughly pulverised and mixed. The examination was carried out as soon after collection as possible. In the case of samples collected by myself, 24 hours was the longest time that elapsed between collection and examination.

F. M. GIBSON.

APPENDIX No. X.

List of Vessels which left Bombay for the other Ports during the year ending 31st December 1897.

1897.	Vessels left for Aden, Red Sea, and Europe.					Vessels left for Ports out of India.					Vessels left for Ports in India, including Burma.				
	Number of vessels.	Number of crew.	Number of passengers.	Total crew and passengers.	Number segregated.	Number of vessels.	Number of crew.	Number of passengers.	Total crew and passengers.	Number segregated.	Number of vessels.	Number of crew.	Number of passengers.	Total crew and passengers.	Number segregated.
January . . .	14	2,110	2,414	4,524	...	19	699	962	1,661	...	16	766	2,024	2,790	...
February . . .	10	1,067	457	1,524	5	37	1,119	925	2,044	5	2,468	20,919	48,456	69,375	165
March	32	4,125	6,456	10,581	31	52	2,446	1,245	3,691	5	4,034	27,292	50,379	77,671	177
April	20	2,176	4,169	6,345	25	39	1,871	541	2,412	13	5,045	38,094	33,157	71,251	231
May	25	2,651	4,082	6,733	16	23	1,266	1,729	2,995	11	5,407	40,880	30,790	71,670	157
June	19	2,017	484	2,501	4	22	1,252	645	1,897	3	1,916	17,964	18,294	36,258	91
July	17	1,768	566	2,334	3	20	1,638	545	2,183	6	1,066	13,089	10,608	22,697	52
August	16	1,738	851	2,589	7	16	1,418	1,277	2,695	9	1,310	13,275	15,885	29,160	86
September . . .	17	1,804	582	2,386	17	19	1,376	1,375	2,751	29	3,444	27,948	4,418	32,366	279
October	20	2,583	3,389	5,972	26	25	1,615	1,204	2,819	42	4,684	35,423	32,621	68,044	649
November . . .	18	2,411	3,439	5,850	16	38	1,656	2,085	3,741	55	5,109	39,297	27,618	66,915	618
December . . .	25	2,938	2,171	5,109	31	65	1,994	1,979	3,973	28	5,558	42,375	30,832	73,207	440
Total .	233	27,388	29,060	56,448	181	375	18,350	14,512	32,862	206	39,957	316,322	305,082	621,404	2,935

JNO. CRIMMIN, *V.C., Major, I.M.S.,*
Acting Health Officer of the Port.

Appendix No. X—*continued.*

List of Vessels which left Bombay for the other Ports from 1st January up to and for 30th November 1898.

1898.	Vessels left for Aden, Red Sea, and Europe.					Vessels left for Ports out of India, other than Aden, Red Sea, and Europe.					Vessels left for Indian Ports, including Burma.				
	Number of vessels.	Number of crew.	Number of passengers.	Total crew and passengers.	Number segregated.	Number of vessels.	Number of crew.	Number of passengers.	Total crew and passengers.	Number segregated.	Number of vessels.	Number of crew.	Number of passengers.	Total crew and passengers.	Number segregated.
January	27	3,129	4,803	7,932	38	63	1,976	2,870	4,846	96	4,771	37,211	40,950	78,170	1,921
February	31	2,301	1,833	4,134	76	66	2,585	1,457	4,042	49	4,716	37,497	37,539	75,036	2,270
March	41	3,385	5,721	9,106	33	50	2,123	399	2,522	13	4,684	38,498	31,856	70,354	1,484
April	52	3,846	2,531	6,377	32	44	2,128	2,228	4,356	22	6,263	49,589	28,843	78,432	1,125
May	50	3,089	1,372	4,461	67	28	1,935	506	2,441	70	7,008	54,589	31,624	86,213	1,535
June	49	2,892	751	3,643	26	19	1,278	425	1,703	28	1,885	19,863	18,083	37,946	483
July	31	2,760	1,082	3,842	50	14	1,442	250	1,692	12	1,021	12,240	11,281	23,521	235
August	20	1,981	505	2,486	48	16	1,473	454	1,927	56	2,364	21,674	20,070	41,744	586
September	19	1,980	544	2,524	38	18	1,478	1,218	2,696	67	3,414	28,720	29,856	58,576	780
October	22	2,369	4,120	6,489	53	17	1,297	1,319	2,616	62	4,646	37,305	47,309	84,614	1,095
November	8	909	1,550	2,459	32	10	477	633	1,110	23	5,539	44,297	46,114	90,411	971
TOTAL	360	28,641	24,812	53,453	493	345	18,192	11,759	29,951	498	46,301	381,483	343,534	725,017	12,485
TOTAL FOR 1897	233	27,388	29,060	56,448	181	375	18,350	14,512	32,862	206	39,957	316,322	305,082	621,404	2,935
TOTAL UP TO 30TH NOVEMBER 1898	360	28,641	24,812	53,453	493	345	18,192	11,759	29,951	498	46,301	381,483	343,534	725,017	12,485
GRAND TOTAL FOR 1897 AND UP TO 30TH NOVEMBER 1898.	593	56,029	53,872	109,901	674	720	36,542	26,271	62,813	704	86,258	697,805	648,616	1,346,421	15,420

	Number of Vessels.	Crew.	Passengers.	Total crew and passengers.	Number segregated.
Total number of vessels, with crew and passengers, which left for Aden, Red Sea, and Europe, from the 1st January 1897 up to 30th November 1898	593	56,029	53,872	109,901	674
Total number of vessels, with crew and passengers, which left for Ports out of India, from the 1st January 1897 up to the 30th November 1898	720	36,542	26,271	62,813	704
Total number of vessels, with crew and passengers, which left for Ports in India including Burma, from 1st January 1897 up to 30th November 1898	86,258	697,805	648,616	1,346,421	15,420
GRAND TOTAL	87,571	790,376	728,759	1,519,135	16,798

The 17th March 1899.

JNO. CRIMMIN, *V.C., Major, I.M.S.,*
Acting Health Officer of the Port.

APPENDIX No. XIII.

REPORT ON PLAGUE

BY

SURGEON-CAPTAIN CHILDE, I.M.S.

I.—ON THE POST-MORTEM APPEARANCES OF PLAGUE.

The bodies examined were for the most part those of well-nourished adults of the servant and labouring classes. Usually the skin was found intact, except that there were cracks and abrasions about the hands and feet, resulting from occupation, and also in many cases marks of the common parasitic skin diseases, especially ringworm and itch; and although clinically various skin-lesions were met with, such as sloughing at the site of the bubo, boils and ulcers, yet in these cases recovery generally took place, and I had no opportunity of observing such conditions in the *post-mortem* room.

The following varieties of plague were met with :—

The Bubonic Form.

The Septicæmic Form or Plague-Septicæmia.

The Pneumonic Form or Plague-Pneumonia.

A.—THE BUBONIC FORM.

The bubo was usually situated in the groin of either side, less commonly in the axilla, rarely in the neck, and most rarely in the supra-trochlear or popliteal region; the limb corresponding to the bubo was swollen and œdematous and petechiæ were usually seen upon it, but they were always in greatest number over the site of the bubo itself; and though there might be some over the body generally, still these were but few. In the case of an axillary bubo the whole axilla looked full and smooth, and the swelling extended down the side nearly to the margin of the ribs, down the inner part of the arm to the elbow, and over the anterior and posterior axillary folds. On dissection there was an enormous mass of dark coagulated blood and serum which occupied the whole axilla and included the glands, so that the whole mass had to be removed together; and on incision this was found to consist of the connective tissue of the part gorged with blood and of coagula due to hæmorrhages, whilst within were seen the glands. In recent cases, of 4 or 5 days' duration, there were some of a deep red and some of a lighter red colour, but all intensely engorged and solid, not breaking down but a little soft from the amount of blood in them; whilst in older cases, 7 or 8 days, the glands were softer, more pink in colour and almost diffluent, suggesting in fact the appearance of a rather soft spleen. The glands were rounded or oval in shape, and varied in size from a walnut to a pea. As a rule too, the smallest glands were the deepest in colour and most solid, whilst the largest were of a lighter red colour and softer consistence. The axillary vessels were pressed upon and surrounded by the enlarged glands and extravasated blood, so that in fact they became incorporated in the bubo, and it was mainly by this pressure on the axillary vein that the œdematous condition of the arm, as referred to above, was produced. The hæmorrhage and coagula extended beyond the axilla and were found in the areolar tissue, as well as amongst the muscles, but more between them than in their substance; this condition also extended down the arm and could be seen in the areolar tissue as far as the elbow. There was also much clear œdema fluid which assisted in forming the swelling, and it was found in the axilla as well as beyond its borders. The bubo thus was found to consist, not of a single enlarged gland, but of a chain of glands of various sizes, surrounded by a mass of engorged areolar tissue coagulated blood and œdema fluid.

In the case of a bubo in the groin there was a similar diffuse swelling in Scarpa's Triangle extending to the neighbouring parts; whilst when the bubo was in the cervical region this swelling was enormous, and pressed upon and embarrassed the larynx and trachea (hence the dyspnœa in these cases). With regard to the remaining lymphatic glands of the body in a bubonic case, there is but little to be said. Thus, in the case of a left axillary bubo, the following condition was found. The left supra-trochlear gland was intensely engorged and the size of a large bean, rather firm and full of dark blood; the right supra-trochlear, right axillary, cervical of both sides and bronchial looked normal or just *slightly* engorged. The mesenteric, iliac, lumbar and popliteal were in the same condition; whilst the inguinal were some as large as beans, pinkish and slightly engorged, others of about the normal size and appearance. It may be mentioned here that the lymphatic vessels presented no abnormality as a rule, except that in some cases those near the bubo seemed to be slightly swollen; the thoracic duct too was either normal or possibly slightly swollen.

Condition of the other Organs.—Hæmorrhages were frequently found beneath the conjunctivæ, in the connective tissue under the scalp, and under the periosteum on the surface of the cranial bones, also extravasations sometimes of large size were occasionally found amongst the muscles, especially in those of the abdominal wall. The occurrence of petechiæ in the skin has been already mentioned.

Nervous System.—The dura mater and pia mater were much engorged, and the appearance of lymph was seen along the course of the larger vessels in the latter membrane; the puncta cruenta in the brain were well marked, but the brain substance itself looked normal, as did the fluid in the ventricles. The spinal cord presented a similar engorged appearance, but showed no other abnormality, and the nerve-trunks appeared to be normal.

Alimentary System.—The tonsils were either normal or enlarged to the size of almonds, of a dusky purple colour, soft and engorged; and similarly the pharyngeal tonsils were either normal or engorged. The parotid and submaxillary salivary glands were either normal or engorged to some extent; the mucous membrane of the pharynx and œsophagus was usually dusky from engorgement. The stomach showed constantly a distinctly engorged appearance with hæmorrhages into the mucous membrane which were usually petechial but sometimes of a larger size. Similar engorgement and petechiæ were frequent in the large intestine and rectum, but were less generally found in the small intestine. (This applies especially to petechiæ.) In some cases Peyer's patches and the solitary follicles looked distinct, prominent and slightly swollen; but usually they were either somewhat distinct or of the normal appearance.

The Liver was always distinctly enlarged and full of blood, but the substance itself was usually rather pale and soft from parenchymatous degeneration, there was bile in the gall bladder either of the usual appearance or thin and watery. Hæmorrhages into the mucous membrane of the gall bladder were rarely seen. In one instance small necrotic patches were scattered through the liver. This case will be described hereafter.

The Pancreas was either normal or engorged.

The Spleen was always enlarged, sometimes to two or three times the ordinary size, the capsule was normal, the spleen-pulp of a brick-red or purple colour and always markedly engorged. It was either fairly firm or rather soft and the Malpighian bodies plainly seen as if each were engorged, so as to give the section sometimes almost a granular appearance.

Urinary System.—The kidneys were always enlarged and much engorged, the capsule stripped easily and petechial hæmorrhages were constantly found beneath it; the kidney substance itself was pale and soft from parenchymatous degeneration. There was distinct engorgement of the pelvis of the kidney with petechial hæmorrhages and sometimes a large clot distending the pelvis and calices. The whole ureter was frequently engorged, and distinct hæmorrhages could be seen under its inner coat. The bladder was usually distended with urine, which was either of the normal or a slightly blood-stained colour; small hæmorrhages were frequently seen in the mucous membrane of the bladder.

The Genital System showed nothing abnormal beyond some engorgement. The supra-renal capsule and thyroid body were engorged but otherwise normal.

The Peritoneum showed considerable engorgement, and hæmorrhages into the retro-peritoneal tissue were frequently found; thus, they were seen on the under surface of the diaphragm, on the upper surface of the liver, especially close to the ligaments, and in one instance there was a hæmorrhage completely enclosing the gall-bladder, so that there was a casing of coagulated blood between the peritoneum and gall-bladder. Similar hæmorrhages behind the peritoneum were found on the surface of the spleen, kidneys and intestines, and sometimes large coagula in the retro-peritoneal tissue of the lumbar region.

Circulatory System.—The pericardial cavity usually contained a few ounces of blood-stained or clear fluid, and petechial hæmorrhages were constantly seen beneath the visceral and parietal pericardium. The heart-muscle was either normal or in some cases rather soft and friable; considerable dilatation of the right side, with *post-mortem* clots in the cavities, was often present. There was not much engorgement of the walls of arteries, but the vena cava and other large veins showed this condition very markedly. On opening the veins distinct petechial and large hæmorrhages were seen under the inner coat, giving it a mottled appearance. Where a large vein, *e. g.*, axillary or femoral, was included in the bubo, this hæmorrhage into its walls was constantly seen, so that the extravasated blood in the gland itself, in the areolar tissue outside it and in the walls of the vein, was all directly continuous. I think that the blood itself was rather more fluid and showed less tendency to clot than is usually seen after death.

The Respiratory System.—There was some engorgement of the larynx and trachea, and the mucous membrane of the bronchial tubes was usually swollen and engorged, sometimes greatly so. There was much general engorgement of the lungs with œdema, and small hæmorrhages into the lung tissue were seen rather frequently. Frothy sero-mucous fluid which was sometimes blood-tinged was found in the bronchi. The pleura showed marked engorgement, and its cavity often contained some blood-stained or clear fluid; sub-pleural hæmorrhages, sometimes of large extent, were commonly found on the upper surface of the diaphragm, on the chest-wall and on the surface of the lungs, especially between the lobes. In cases of cervical bubo the engorgement and œdema extended to the larynx, and œdema of the glottis was present.

Note.—A variety of the bubonic form of plague must be mentioned here, for, instead of finding one large bubo, such as has been described above, the following condition was observed. A chain of enlarged glands was found in the inguinal region and it extended into the pelvis right along the iliac artery as far as the lumbar glands. These glands were dark-red, soft and friable and intensely engorged and looked like soft spleen tissue; there was great engorgement, extravasation and œdema around them, and they surrounded the iliac artery and vein, so that in dissecting out the gland mass these vessels came away enclosed in it. The glands were as large as almonds or smaller and were so incorporated in the coagulated blood that it was scarcely possible to dissect them out. The remaining glands and other organs in the body were in the condition described above.

B.—The Septicæmic Form or Plague-Septicæmia.

In the bubonic form of plague, one set of glands with extravasated blood around them forms the bubo, and there is practically no alteration in the remaining glands of the body; but in the septicæmic form there is no such bubo, yet there is a general involvement of nearly all the lymphatic glands. Yet though so many glands show evidence of disease, one gland or several glands of one set show characteristic changes which are pathognomonic of this type of plague. These appearances are:—The gland is enlarged to the size of an almond or less, is rounded, firm and pink in colour; on section it shows some but not much engorgement and some œdema, its substance is rather soft and can be easily scraped off with a knife, and sometimes small softening areas were present. There was no hæmorrhage in the areolar tissue around this gland and at most only a little œdema and trifling engorgement of the vessels. Commonly there were one or several such glands in one inguinal region, and usually the lowest gland of the chain was most markedly affected; whilst those higher up varied in size from a bean to an almond, and had the same firm pink appearance though there were at times some which looked nearly normal in size and shape. The iliac glands of the same side were similarly affected, as large as almonds and either pink and firm or softer and of a dark red colour. The inguinal glands of the opposite side showed similar changes, but sometimes to a less extent, and the iliac sometimes showed slighter changes or some of them looked normal. The lumbar usually showed slight enlargement and were either pale and soft or somewhat pink and firm. The cervical and axillary varied in size from hazel-nuts to peas and usually showed merely engorgement, being full of dark blood; but sometimes some of them showed the pink firm appearance described above. The mesenteric were enlarged to the size of peas and beans and were either slightly or considerably engorged. The supra-trochlear and popliteal were normal or engorged. There was no hæmorrhage or œdema around any of the abovementioned glands, and no enlargement of the lymphatic vessels was observed. The condition of the remaining organs was such as has already been described under the bubonic form.

Note.—In several cases of Plague-septicæmia where death had occurred shortly after attack, the glands were found slightly enlarged, of a dark red colour and contained much blood and œdema fluid. This appeared to be an earlier form of the characteristic pink plague glands described above. The difference between the bubonic and septicæmic form of plague appears to be this:—In the bubonic form the plague bacillus after entering the body is arrested at the nearest group of glands, grows here vigorously, and as a result of its growth the bubo is formed. Here the bacillus forms the toxins which are discharged into the system and cause the symptoms of plague, but the glands of the bubo form a barrier which prevents the bacilli from passing on and growing generally throughout the body; and it is only shortly before death, in fatal cases, that this resistance is overcome and the bacilli are able to pass on into the system generally. But in the septicæmic form the bacillus, after entering the body, meets with feeble resistance at the nearest glands; it speedily overcomes all opposition and passes on to infect other glands and organs where it grows abundantly. These points will be illustrated later in the detailed account of autopsies.

It may be mentioned here that no bubo of the mesenteric glands was ever found; these glands were always examined, and though changes might be found in them, they were always less marked and less distinct than plague glands found in other parts of the body. In short, there was no autopsy which went to show that the plague bacillus had reached the stomach or intestines, *e. g.*, in food, and thence infected the mesenteric glands.

C.—The Pneumonic Form or Plague-Pneumonia.

In this form of plague the only marked evidences of disease are found in the lungs, whereas the lymphatic glands and other organs are scarcely affected at all. The lungs were in the following condition:—There was general engorgement with considerable œdema, a reddened condition of the mucous membrane of the bronchi, but no marked evidences of bronchitis, and frothy watery fluid, sometimes blood-stained, could be squeezed from the bronchi. (Pus in the bronchial tubes was only found on one occasion.) A number of pneumonic patches were found scattered through the lungs, varying in size from a pea to an egg. They were light pink or red grey in colour, solid, airless and sank in water; they were rounded in shape and usually separated by a distinct ring of engorgement from the crepitant lung around. Some, instead of being pink, were of a deep blood colour throughout and less solid, and some of these had a small greyish more solid centre. Those of the patches which were situated on the surface of the lung were prominent and projected distinctly from the surface; whilst the pleura over them was roughened and showed signs of early inflammation. These patches had in fact the appearance of the first and second stages of lobular pneumonia, but no patches were found which had passed on to the third stage of softening and breaking down. In a few cases larger masses of pneumonic lung than these were found, and once about half the lower tube was found in this condition. Petechial hæmorrhages were usually found on the surface of the lung; the bronchial glands were either enlarged, swollen, œdematous, soft and distinctly engorged, or else they were small and of the usual appearance, perhaps a little engorged. The remaining lymphatic glands throughout the body showed none of the appearances of either the bubonic or septicæmic form of plague; most of them looked absolutely normal, and the only noticeable change was that the axillary, and sometimes the cervical chains were a little engorged.

The description of the remaining internal organs already given applies equally to this form of plague, except that the large hæmorrhages were absent, but petechiæ on the surface of the heart, in the pelvis of the kidney, bladder, stomach and intestines were commonly present. Petechiæ in the skin were not observed in this form of plague.

Reference must be made here to a variety of this form of plague which may be shortly described as a combination of Plague-Pneumonia with Plague-Septicæmia. In this condition the lungs were found in the state which has just been described, pneumonic patches being scattered through them; and in addition the lymphatic glands of the body presented the appearances seen in cases of Plague-Septicæmia. Thus in these cases the plague-bacilli had specially infected both the lymphatic glands and lungs, whereas in the varieties of plague treated of above, only one or other of these tissues was the special focus of disease.

Allusion must also be made at this place to one case of Plague-Septicæmia, in which the lungs contained a patch of ordinary pneumonia which was not due to plague. This case will be described in detail later on.

II.—MICROSCOPIC PATHOLOGY OF PLAGUE.

A.—The Bubonic Form.

The areolar tissue around the glands of the bubo is intensely engorged, free hæmorrhage is seen in the areolar tissue and fat, and all the vessels visible are full of blood, and their walls deeply engorged. The glands are uniformly full of extravasated blood throughout, with more intense hæmorrhages here and there, and the gland tissue is so overlaid with blood as to be scarcely visible; in some, probably earlier, glands, the blood-cells are distinct; in others, probably older, they are not so distinct, and the gland is stained with blood colouring matter, softer, showing granular debris, and beginning to break down in parts. Still there is no distinct appearance of pus, and it seems to be a necrotic softening. In some of the smaller glands the exact early appearance is seen; the whole gland is infiltrated with blood, the blood corpuscles being distinct and at parts there is a large deeply-stained hæmorrhage occupying half or more of the gland. So intense is the hæmorrhage that in most glands there is no distinction between cortex and medulla, nor can the gland tissue or blood and lymph-vessels be easily made out, but the walls of such vessels as are seen are deeply engorged both in the gland as well as at the hilus. Such lymph-vessels, as can be seen particularly at the hilus, are full of lymph corpuscles, and there is some engorgement of their walls, and sections of the lymph-vessels seen outside the gland, shew the same appearance. Specimens were cut to shew the glands of the bubo lying against and around the axillary artery and vein; here there is intense engorgement of the walls of these vessels with hæmorrhage into them, but much more of the vein than of the artery; in the vein the extravasated blood comes in most parts right through its wall into the inner coat and as far as the lumen; so that at these parts the inner coat cannot be properly seen at all. Hence one sees the plague gland lying right against the vein, with extravasated blood in the gland in the little connective tissue outside it, and then in the vein-wall as far as the lumen; and thus there is a direct path for the passage of the plague bacillus from the gland to the lumen of the vein and so into the general circulation. A similar condition of affairs was observed in those cases in which instead of a bubo, there was a chain of enlarged plague glands, *e. g.*, along the iliac artery and vein. The remaining glands of the body in a bubonic case showed either a normal appearance or a little engorgement of vessels.

Lung.— A section of the lung shows blood-cells in all the vessels as well as in the alveolar capillaries; the vessels under the pleura always contain blood, and large hæmorrhages are sometimes present here; scattered about, areas are seen where blood-cells are present in the alveoli themselves, and similarly blood-cells may be seen in the smaller bronchial tubes. The vessels of the walls of the bronchi, like those of the rest of the lung, are distended with blood; the bronchial mucous membrane shows no special change. Specimens of lung stain well.

Liver.—All vessels are engorged and the specimen has the appearance of early nutmeg disease. The central veins are wide, as are the capillaries round them, and the portal veins are also distended with blood-cells; around the distended central and portal veins there is fine granular pigmentation of the liver-cells. Engorged vessels are usually seen well just beneath the capsule of the liver, and there may be hæmorrhages here. The nuclei of the liver-cells stain badly and the cells have a cloudy indistinct appearance as of parenchymatous degeneration.

Spleen.—The vessels generally, both large and capillary, are distended with blood-cells, and this is more marked in certain distinct areas; here a dilated vessel is seen full of blood and round it an area of engorged capillaries, with hæmorrhage into the spleen tissue, blood-cells being seen amongst the spleen-cells. Engorged vessels are also seen in some glomeruli, and a vessel distended with blood leading to the glomeruli; further distended vessels with hæmorrhages around them are usually well marked under the capsule of the spleen. Section of spleen stain well and the cells are distinct.

Kidney.—The vessels, both large and capillary, are distended with blood-cells at places, vessels have ruptured and hæmorrhage is seen into the kidney substance. This condition is marked immediately beneath the capsule. Blood-cells are seen in many of the tubules, but more so in the straight than in the convuluted tubes, and some of the glomeruli are likewise engorged. The epithelium of the tubules is swollen and in a condition of parenchymatous degeneration and the nuclei of the cells stain badly; but this condition is more plainly seen in the convuluted than in the straight tubes. Some specimens show engorged vessels with hæmorrhage at the pelvis of the kidney.

Ureter.—The vessels of the walls of the ureter are distended with blood, and hæmorrhage has occurred into the walls, blood-cells being seen in the mucous membrane even as far as the lumen the condition is similar to that found in the walls of veins.

Stomach and Intestines.—The vessels are distended with blood, this condition being best seen in the submucosa; at places small hæmorrhages have occurred. The epithelium does not stain well. Nothing abnormal was seen in Peyer's patches.

Brain and Spinal Cord.—The large vessels and capillaries of the pia mater are distended with blood, but no special changes have been seen in the substance of the brain or spinal cord.

Muscle.—In specimens of voluntary muscle some fibres are seen well-stained and distinctly striated, but mixed with them are others which are badly stained, with striation faint or absent, and the muscle-substance is swollen, broken up into irregular lumps and of a shiny homogeneous appearance. Specimens of the *heart-muscle* showed this condition also.

Note.—This degeneration of heart-muscle is associated with the dilatation of the heart and nutmeg condition of the liver found *post-mortem*; and also with the fact that plague-patients are liable to die suddenly of heart-failure.

Blood-vessels.—In the outer coat of large arteries the blood-vessels are found full of blood, and the capillaries of the middle coat may also be seen distended; but the inner coat is always perfect, distinct and intact, and its elastic tissue plainly visible. The walls of large veins, however, show much more engorgement, and in these, large collections of blood may be seen immediately beneath the inner coat, extending as far as the lumen, and at parts the inner coat is either extremely thin or cannot be traced over the hæmorrhage. This condition is best seen in vessels incorporated in a bubo, but is also to be found in the vena cava, iliac veins, etc.

The following organs were also examined, but nothing was observed under the microscope except some engorgement. The tonsils, salivary glands, thyroid body, breast, male and female generative organs, cartilage, nerve and thoracic duct. Sections of the skin were also made and showed engorged capillaries with small hæmorrhages where petechiæ were visible in the surface.

B.—The Septicæmic Form.

Lymphatic Glands.—This areolar tissue around the plague-glands (*i.e.*, the characteristic glands already described) shows none of the intense engorgement seen in the bubonic form. The plague-glands themselves are well stained and all their anatomical features are distinct. All the blood-vessels in the gland are distended with blood-corpuscles, and at parts hæmorrhage has occurred into the gland-substance, which is most frequently seen beneath the capsule, but may also be at other parts. The lymphatic vessels and lymph channels in the gland are wide and distended with lymph-corpuscles. The distention of the blood and lymph vessels is always most marked at the hilus, and there may be hæmorrhages into the areolar tissue here. In some glands small areas may be seen, where softening and breaking down is taking place, granular debris and broken-down cells being seen here. The glands shew these changes in varying degree; in some there is merely slight engorgement with some distension of lymph-vessels, in others there is wide distension of both kinds of vessels, with some amount of hæmorrhage into the gland tissue; whilst in others again there are many hæmorrhagic areas which may occupy half or more of the gland, and it is in these glands that breaking down is usually seen. In a septicæmic case the glands, which have not the characteristic plague appearance, shew under the miscroscope either slight engorgement or normal features.

With regard to the remaining organs the appearances described under the bubonic form apply also to the septicæmic form of plague.

C.—The Pneumonic Form.

A section of lung-tissue, apart from a pneumonic area, shows great engorgement of all large blood-vessels, and of the alveolar capillaries as well, and patches of hæmorrhage into the alveoli around these engorged vessels are seen scattered about. In a pneumonic area three zones can be made out. At the circumference there is intense engorgement of all vessels including alveolar capillaries, the alveoli are full of blood, and the hæmorrhage is so intense that many of the alveolar septa are broken down, entirely absent or represented by mere shreds. Within the circumference is seen a zone in which the alveoli are intact and are completely filled with well-stained cells, so that there is no interval between the alveolar walls and their contents; and at the centre is one universal mass of similar cells, and the cellular infiltration is so extreme that the walls of the alveoli are scarcely visible. Such is the general arrangement of the pneumonic patch, although there may be alveolar hæmorrhage in parts of either the middle or central zone.

Under a higher power the alveoli of the circumference are seen to be completely filled with blood-corpuscles, and there is scarcely any appearance of fibrin, or none at all; in the middle zone the alveolar contents consist for the most part of catarrhal epithelium with some white and a few red blood-corpuscles, and a little fibrin or none at all, whilst the dense central mass of cells consist of catarrhal epithelium and leucocytes with some granular debris. Thus the pneumonic area has the appearance of very extreme lobular or catarrhal pneumonic.

The walls of the bronchial tubes, as well as of the large veins, show great engorgement, and there are hæmorrhages into the vein-walls. Blood and catarrhal cells may be seen in the finer bronchi, but the bronchial mucous membrane is scarcely altered, there being at most a little cellular proliferation. There are the appearances of acute pleurisy over those pneumonic areas which project upon the surface of the lung, with hæmorrhages beneath the pleura.

The bronchial glands show engorgement of blood-vessels, some hæmorrhage into the gland tissue and distended lymphatic vessels; but in some cases these conditions are only slightly marked and the glands looked nearly normal. The remaining lymphatic glands in the body looked either normal, or presented the characters described above to a slight extent.

With regard to the other organs, the description given under the bubonic form of plague applies here also, except that generally engorgement and hæmorrhage are less marked.

D.—The Plague Bacillus in Situ.

Sections of the various organs and lymphatic glands were prepared to show the plague bacillus *in situ;* they showed best when stained with Löffler's methylene blue or carbol-fuchsin, but they could not be demonstrated with Gram's method.

In the glands of the bubo the bacilli could be seen in enormous numbers, both amongst the cells of the gland-tissue and also in the lymphatic vessels; they were also seen amongst the blood-corpuscles extravasated into the gland, as well as in the hæmorrhage outside the gland. In cases of plague septicæmia they were similarly present in the enlarged characteristic glands. In the kidney the bacilli could also be seen especially among the blood-cells of the tubules into which hæmorrhage had occurred; in the spleen they were also present, sometimes in large numbers amongst the cells of the spleen-tissue and in the hæmorrhagic areas; similarly they were found in the liver, especially in those cases where engorgement and extravasation were marked.

In cases of plague-pneumonia, the bacilli were seen in abundance in the pneumonic areas; they could be found in profusion amongst the catarrhal epithelial cells and leucocytes which filled the alveoli and terminal bronchioles, as well as among the blood-corpuscles of the alveoli into which hæmorrhage had occurred. Similarly in the lungs of non-pneumonic cases they could be seen, but in far less numbers, and mostly where small hæmorrhages had occurred into the alveoli.

Note.—These specimens were only prepared from cases where the *post-mortem* was made immediately after death, and in which the presence of the plague-bacillus had been proved to be present by the method of cultures, so as to avoid the fallacy of diagnosing plague bacilli from their microscopic appearance alone.

III.—CASES TO ILLUSTRATE THE VARIOUS FORMS OF PLAGUE.

A.—The Bubonic Form.

Bubo in the Left Axilla.—R. N., male, Hindu, aged 40 years, admitted 1st March 1897, says he got suddenly ill four days ago with fever and severe rigors; temperature on admission 104·8° F., pulse 110, has pain in left axilla. March 2nd.—Temperature 103·2, pulse 110, still pain in left axilla, and swollen glands are felt. During the day a large, doughy, diffuse swelling arose in the axilla, and there was much more pain. March 3rd.—Temperature 100, the swelling filled out the whole axilla and was very painful. Patient died at 9-30 A.M.

Post-mortem examination one hour after death.—Œdema and petechiæ of left arm; old abrasions on hands and feet; large swelling in left axilla, with small petechiæ on the skin over it. The whole of the left axilla was occupied by a mass of coagulated blood and serum, and within the mass the axillary glands were found; they varied in size from almonds to peas, and were all intensely engorged, deep or lighter red and a little soft; the axillary vessels were included in the bubo thus formed of coagula and swollen glands. The hæmorrhage and œdema extended beyond the borders of the axilla in all directions.

Left supra-trochlear gland intensely engorged and the size of a large bean.

Right supra-trochlear, right axillary, and cervical chains on both sides were a little engorged but of normal shape; the popliteal were normal; the inguinal were some as large as beans, and some smaller or of normal size; they were all slightly engorged, on the right side rather more than on the left. The iliac and lumbar were a little engorged, and the mesenteric slightly so, the bronchial glands looked normal. There was no hæmorrhage or œdema round any of these glands.

Heart.—Some sero-sanguineous fluid in pericardial cavity and small sub-pericardial petechiæ; dark blood in cavities of heart, mostly on right side. Hæmorrhages into walls of vena cava seen well under inner coat.

Lungs.—A little blood-stained fluid in pleural cavities, many sub-pleural hæmorrhages of petechial and larger size. Intense engorgement, with some hæmorrhages into lung tissue and some œdema of lungs.

Liver.—Large, and all vessels, both hepatic and portal gorged with blood; liver-substance rather soft; large sub-peritoneal hæmorrhages on the surface of the liver, specially along the ligaments.

Tonsils.—Swollen and engorged; mucous membrane of stomach and intestines engorged, and small hæmorrhages in stomach and large intestine. Hæmorrhages under serous coat of intestines.

Spleen.—Large, brick-red and somewhat soft, and many small hæmorrhages under its serous coat.

Kidneys.—Large, and all vessels engorged, the kidney-substance itself rather pale and soft. Many small hæmorrhages under the kidney-capsule and coagula distending the pelvis of each kidney. Hæmorrhages into walls of ureters and bladder distended with urine.

Distribution of the Plague Bacillus.—In this case the plague bacillus was found in the various organs as follows:—It was present in enormous numbers in the glands of the bubo, and in immense but diminished numbers in the blood, as well as the œdema fluid from the left axilla. The right axillary glands, the supra-trochlear and cervical of both sides showed a considerable number of plague bacilli, but far less than the bubo. The lumbar also showed them in considerable numbers, but they were rather less in the iliac and inguinal chains of both sides. A few were seen in the mesenteric glands. A specimen of blood taken from the left ventricle of the heart and from various large veins in the body showed many plague bacilli, but far less than in the blood taken from the bubo. Immense numbers were found in the spleen and liver, almost as many as in the glands of the bubo; and some, but far less, in the lung and kidney.

In point of fact it appeared from these specimens that the bacillus had grown most abundantly in the glands and blood of the bubo, and next in the spleen and liver; whereas in the remaining lymphatic glands and other organs it was present in about the same numbers as in the blood of the general circulation, and the bacilli seen in these specimens were probably those contained in the blood of the respective organs. Possibly it might have grown to some extent in some of the lymphatic glands, as indicated by the above specimens.

Note.—In a case of this nature, where there is extravasated blood around the glands of the bubo, which extends through all the coats of the large vein (the axillary in this instance), and where there are enormous numbers of plague bacilli in this extravasated blood, there appears to be a direct path for the passage of the plague bacilli into the lumen of the vein and so into the blood of the general circulation.

B.—CASE OF A BUBO EXTENDING ALONG THE ILIAC VESSELS.

M. R., Hindu, male, aged 27 years, admitted January 26th, 1897, says he has been ill two days. The left inguinal glands are large, painful and tender and the left leg is swollen, is much exhausted, and died one hour after admission.

Post-mortem examination made three hours after death. Body well-nourished, rigor-mortis present.

The Left Inguinal glands were as large as almonds, rather soft, red and distinctly engorged; the lower ones showed this condition markedly, but some of the higher to a less extent. There was no hæmorrhage around these glands.

The Left Iliac were all dark red, soft, friable and intensely engorged and looked like soft spleen tissue; there was great engorgement, extravasation, and œdema around the glands, and they surrounded the iliac artery and vein, so that the whole mass of coagula, glands and vessels had to be removed together. There was no rounded bubo as in the former case, but a chain of swollen glands with hæmorrhage around them extending along the vessels.

Lumbar Glands.—The lower ones were rather large, soft and engorged, but much less than the iliac, and there was but little extravasated blood around them. The upper ones showed even fewer changes, and some looked normal.

The Right Femoral and Right Iliac were normal. The remaining glands looked normal, except that the right axillary were engorged, two of them being as large as almonds, and the right supra-trochlear was likewise engorged to the size of a large pea.

With regard to the remaining organs, the heart showed some dilatation of the right side, and the lungs a great deal of engorgement and œdema; there were petechiæ under the pleura and pericardium. The liver and spleen were both large, dark and full of blood, and the kidneys large, soft and engorged. There were some petechiæ in the stomach, and the brain and its membranes were engorged.

Distribution of the Plague Bacillus.—The enlarged left inguinal glands contained well-stained plague bacilli in considerable numbers; specimens of the left iliac glands showed them in immense numbers, as did those from the lower lumbar glands, but the higher lumbar showed less. The right inguinal and iliac, the axillary and cervical of both sides and the bronchial glands showed only a few plague bacilli, but of this series the right axillary specimens showed rather more than the others. The lung, liver, spleen and kidneys similarly contained a few, as did the specimen of blood taken from the heart; in fact, apart from the bubo the remaining lymphatic glands and organs merely showed about as many plague bacilli as the blood.

C.—THE SEPTICÆMIC FORM.

P. S., Hindu, male, 30 years old, was admitted on the 19th February 1897. His friends said he had been ill with fever for about four days and had been delirious for one day. He died immediately after admission. The *post-mortem* examination was made one hour after death. No petechiæ on surface of body.

Lymphatic Glands: Right Inguinal.—The lowest was the largest, of the size of a small almond, and of the others some were nearly as large and some smaller; they were rather firm and pink and of the characteristic plague appearance.

Left Inguinal.—The lowest was like a small almond, those above quite small and the highest as large as beans; all were slightly firm and pink, but in an earlier stage than on the right.

Right Iliac.—The three lowest were like large almonds, pink and firm, but the upper were smaller.

Left Iliac.—The lowest was like a small almond, but red and full of blood and rather soft, the upper ones were like small beans and less engorged. The *Lumbar* were like small peas and beans, all rather red and firm. The *Mesenteric* were enlarged to the sizes of small almonds, beans and peas, and were all dark red, engorged and soft. *The Right and Left Axillary* were light red in colour, and rather firm, some being as large as hazelnuts and some smaller. The *Cervical* chains showed a similar appearance, whilst the *Supra-trochlear* and *Popliteal* glands were small and pale.

There was no inflammation of lymphatic vessels and no hæmorrhage or œdema round the glands in this case, so that there was no appearance like the bubo described in former cases. The condition of the remaining organs was such as has been already described, and it only remains to notice that there were many small hæmorrhages in the lungs.

Distribution of the Plague-Bacillus.—Specimens taken from the inguinal, iliac and axillary glands of both sides showed enormous numbers of distinct well-stained plague-bacilli; specimens of the lumbar and mesenteric glands showed the same appearance. The cervical glands showed them also, but in less numbers, and the bronchial, supra-trochlear and popliteal glands still less. A large number of specimens to show the bacilli were made from the glands of each region, and, as a general rule, those glands which were largest and most distinctly altered showed the greatest number of plague bacilli. Specimens of the spleen contained many of the bacilli, but less in number than the plague glands. The liver and kidneys showed plenty, but fewer than the spleen, and the lungs still fewer. The blood contained a fair number, about as many as in the lung.

Note.—In this case the mesenteric glands showed distinct changes and contained many plague bacilli, but in some other cases of this type these glands were only slightly altered and presented a few plague-bacilli: and, as a general rule, the peripheral glands were most obviously altered and contained the bacilli in the greatest number, whereas the visceral were more normal-looking and showed the bacilli only in small numbers.

D.—THE PNEUMONIC FORM.

R. F., Hindu, male, 23 years old, admitted on January 31st, 1897, complaining of fever and cough of four days' duration. He looked very ill, temperature 102, and he had dyspnœa and cough. There were physical signs of pneumonic patches in the lungs. He complained of no pain whatever, nor was any enlargement of lymphatic glands made out. He remained very well and died on February 2nd. *Post-mortem* examination seven hours after death. No petechiæ on surface of body, body well-nourished and plenty of subcutaneous fat.

Heart.—Muscle rather soft and flabby and dilatation of the right side with slightly coagulated blood in the cavities.

Lungs.—Much general engorgement and œdema of lung-substance, some congestion of bronchial mucous membrane, with frothy sero-mucous fluid in trachea and bronchi. Distinct rounded nodules in the early second stage of pneumonia were distributed in the lungs as follows:—There were five such nodules in the right upper lobe, varying in size from a hazelnut to an egg, and a few in the rest of this lung, with one mass quite at the base; also the left lung contained a few similiar pneumonic patches. Those on the surface projected and there was early pleurisy over them, also petechiæ under the parietal pleura generally. The nodules were surrounded by a ring of engorged lung in the first stage of pneumonia. The liver, spleen and kidneys were large and engorged, and the bladder full of urine; the intestines rather engorged with some petechiæ in the stomach, the brain and its membranes engorged.

Condition of Lymphatic Glands.—Bronchial, enlarged and a little swollen and engorged.

Cervical, normal; *Axillary,* a little swollen, mostly on the right side.

Supra-trochlear and *Popliteal*, normal.

Inguinal, slightly enlarged.

Iliac, Lumbar and *Mesenteric*, normal.

Distribution of the Plague-Bacillus.—The pneumonic lung in the second stage shows immense numbers of early well-stained bacilli, and some of them are collected into large masses or groups ; the pneumonic lung in the first stage shows the same appearance, but not so many of the masses. The general lung-tissue shows many of the bacilli, but far less than the pneumonic patches. The fluid obtained from the trachea and bronchi also shows the bacilli in large numbers. The bronchial glands contained plague bacilli in considerable numbers. The spleen showed a few, the liver rather more and the kidneys still more, but nothing like the numbers in the lungs. The blood of the general circulation showed extremely few, just one here and there.

The axillary and cervical chains, the lumbar, iliac, mesenteric and inguinal glands showed extremely few, only one here and there as was seen in the blood. Thus the plague-bacilli were present in enormous numbers in the lungs and only to a very slight extent in the lymphatic glands and remaining organs.

Note.—In some other cases of the pneumonic form of plague, fewer of the bacilli were seen in the bronchial glands and kidneys than in this instance.

E.—PLAGUE-PNEUMONIA WITH PLAGUE-SEPTICÆMIA.

K. B., Hindu, 31 years of age, was admitted on February 23rd, 1897, for fever and cough, said to be of five days' duration. He was extremely ill and there were physical signs of pneumonic patches in the lungs; also enlarged glands could be felt in the groins and axillæ. His temperature varied between 103 and 105, delirium set in, and he died on February 26th. *Post-mortem* on February 27th, twelve hours after death ; there were no petechiæ on the skin.

Heart.—Right side dilated, muscle rather soft.

Lungs.—Much blood-stained, watery fluid in trachea and bronchi, much general engorgement and œdema of lungs. There were many distinct, solid pneumonic patches, each surrounded by a well-marked ring of engorgement ; six such patches in the right lung and five in the left. The patches on the surface had early pleurisy over them, and there were sub-pleural petechiæ. There were also five or six areas of mere engorgement, not consolidated but full of blood and of intense purple-red colour ; they were patches in the first stage of pneumonia.

Bronchial glands, rather engorged and soft.

Liver, Spleen and Kidneys, large and engorged.

Stomach and Intestines engorged and some petechiæ.

Lymphatic glands : Right Popliteal, two the size of beans rather red and firm, the left one normal.

Inguinal on both sides. The lowest were the largest, like walnuts partly red, partly cream colour, all rather firm ; the upper were all smaller, like beans, some being red and some pale.

Iliac.—The lowest on each side was like a large almond, the others like beans ; all were of a cream colour and rather soft.

Lumbar.—Pink, soft and as large as beans, some of them almost diffluent.

Mesenteric.—Some normal, some like beans and slightly red.

Supra-trochlear.—Right, like a large bean, purple-red, engorged and firm. The left was normal.

Cervical.—The highest on each side was like an almond, swollen, firm and deep-red ; of the lower ones some looked normal and some engorged.

Axillary, as large as hazelnuts, beans and peas, the larger ones being much engorged and the smaller less so.

There was no hæmorrhage, engorgement or œdema of the areolar tissue around these sets of glands respectively.

Distribution of the Plague-Bacillus. Lung.—Second stage of pneumonia ; enormous numbers of plague bacilli ; first stage of pneumonia, plenty, not so many as above ; and general lung tissue far less.

Fluid in Trachea and Bronchi.—Enormous numbers of plague bacilli.

The Bronchial Glands showed only a few.

Liver and *Kidney*, a few ; *Spleen*, rather more.

Blood, present, but not in large numbers.

Lymphatic Glands. Right Inguinal showed enormous numbers and so did the left, and generally the larger glands showed more of them than the smaller.

The Right and Left Iliac showed immense numbers.

The Lumbar showed large numbers, but not so many as the above.

The large upper *Cervical* glands on each side showed huge numbers, and the lower glands less.

The large *Axillary* glands of both sides showed large numbers, and the smaller glands a few.

Right Supra-trochlear gland contained immense numbers, and the left extremely few.

Right Popliteal contained a few, and the left scarcely any.

The Mesenteric contained very many, presenting almost the appearance of the large inguinal glands.

Thus in this case the plague-bacillus was found in enormous numbers in the pneumonic patches of the lungs, as well as in nearly all the lymphatic glands of the body ; whereas the remaining organs showed it to an inconsiderable extent.

It will be convenient here to give an account of two further cases which were of considerable interest.

F.—CASE OF PLAGUE-SEPTICÆMIA. WITH SECONDARY DEPOSITS IN THE LIVER, AND PNEUMONIA WHICH WAS NOT DUE TO PLAGUE.

S. D., female, aged 60, was admitted on 9th March 1897. She was delirious, was in a very weak condition and had some cough ; the inguinal glands were felt to be enlarged, but were not painful ; temperature 102·8. She remained delirious and very ill, and died on March 12th. The duration of illness was unknown. *Post-mortem* examination made two hours after death.

Heart.—Some dilatation of right side.

Lungs.—Old thickened pleura with firm adhesions over both lungs, with some engorgement and hæmorrhage in the adhesions. Considerable engorgement and œdema of both lungs generally were present. There was one patch of pneumonia in the early second stage, the size of an egg, behind and below the right apex ; it was irregularly oval in shape, of a dusky red colour and not distinctly round and marked off from the lung-tissue, as in the cases of plague-pneumonia described above.

The Liver was most peculiar ; it was slightly enlarged and congested as in the early nutmeg condition, and was stuffed throughout with small yellow rounded masses in size from pin's heads to peas. They were rather soft and friable but not fluid, and there was no area of engorgement around them. They were found both on the surface and throughout the whole substance of the liver. They looked like necrotic foci.

Spleen, rather large and a little engorged.

Kidneys, senile degenerative changes and a little engorgement.

Intestines, some general engorgement of the stomach and intestines, and distinct petechiæ in the mucous membrane of stomach and large intestine. There were no deposits in any of these organs such as were found in the liver.

Condition of Lymphatic Glands. Right Inguinal, the lowest was the largest like a walnut, light red and firm ; the higher ones were smaller and paler and one of them contained a small softening area.

Left Inguinal, the lowest was like that on the right side and the upper ones slightly enlarged and red.

Right and Left Iliac, the lowest was like an almond light red and rather firm, and the upper ones much smaller and paler.

Lumbar, small and nearly normal.

Bronchial, rather large and engorged.

Supra-trochlear, right, small and normal-looking ; left, slightly large, soft and pink.

Axillary on both sides, were all red and engorged, and varied in size from a pea to a hazelnut.

Cervical, like the axillary.

Mesenteric, some looked a little enlarged, soft and pink, and some looked normal.

Distribution of the Plague-Bacillus. Glands, Right Inguinal. A considerable number of well-stained plague-bacilli.

Left Inguinal.—Enormous numbers, on both sides, fewer seen in the smaller glands.

Right Iliac, a fair number, and *Left Iliac,* many more; seen best in the large glands.

The Axillary and *Cervical* glands showed a few plague-bacilli; the *Right Supra-trochlear* very few, and the *Left Supra-trochlear* an enormous number, just like the large Left Inguinal glands.

Liver.—In the yellow masses described above an enormous number of distinct plague-bacilli were seen, whereas the liver generally showed only a few, about as many as in an ordinary case, and far less than in the yellow patches.

Sections of the liver were also examined and presented the following appearance:—The liver was in the earl nutmeg condition, the central veins dilated, with som blood corpuscles extravasated around them, the portal vessels also congested and fat globules in the adjoining liver-cells. The liver-substance was stained badly and, scattered through it, the above-mentioned masses were seen, all better-stained than the liver-cells and looking finely granular; some were large, some small, and some seen under the microscope which were not visible to the naked eye. The small ones were granular and stained well throughout, but the large were breaking down in parts and irregularly stained. The small ones were distinctly rounded and no liver-tissue was seen in them, but some of the large were less regular in shape and contained some distinct remains of liver-cells: these were probably two or three adjoining masses which had coalesced. Speaking generally, the small masses mere mostly situated near the portal spaces, but this could not be said of the larger, as some were as big as two or three lobules. Under higher power the masses were seen to consist of leucocytes, pus-cells, granular debris and remains of liver-cells, and there appeared to be an excess of leucocytes in the surrounding capillaries; in fact the structure of the masses resembled that of small early abscesses.

Specimens of the liver were also prepared to show the plague-bacilli *in situ* in the sections; enormous numbers of them could be seen in the masses and only a few in the general liver-tissue.

Cultures also were made from the masses, and typical colonies of the plague-bacillus grew in abundance. Thus these small necrotic masses resulted from the growth of the plague-bacillus in innumerable definite areas throughout the whole liver, and are comparable with the pneumonic patches found in cases of plague-pneumonia due to the same cause. This condition of the liver was extremely rare and was only observed in two other cases during the Bombay epidemic, once by the Austrian and once by the Russian Plague Commission. No similar condition was ever found in the spleen or kidneys to the best of my belief.

Lung.—Cultures made from the pneumonic patch showed the appearance not of plague but of Fraenkel's Pneumo-coccus, and specimens taken from the patch showed the same pneumo-coccus under the microscope. Cultures made from the inguinal and axillary glands, from the spleen and from the heart's blood all showed the typical growth of plague. These cultures were made by Professor Bitter, who has kindly permitted me to make use of his results.

Note.—This was the only case amongst the autopsies on plague made by myself in which secondary pneumonic was found, not due to plague.

G.—CASE OF PLAGUE IN A PREGNANT WOMAN. SURVIVAL OF THE FŒTUS: DEATH OF THE MOTHER.

D. R., Hindu woman, 25 years old, was admitted to hospital for child-birth on 15th April 1897 at 11 P.M. She stated that she was five days short of her full term of gestation, that for the past several days she had had fever preceded by rigors, and that a few hours before admission she felt some pains in the abdomen of a bearing-down character and thought she was about to be confined.

On admission she was examined and found not to be in labour, and the pains were thought to be false. She was quite conscious and able to walk; temperature 102. She stated that she had two children and that her previous confinements were normal.

On 16th morning, temperature 102, no pain in abdomen, slight pain and tenderness over right inguinal region, and some glands could be felt a little enlarged. Patient had a peculiar drowsy expression of features, with injection of conjunctivæ, and looked very ill. The temperature remained high and at 4 P.M. was 104. At this hour labour pains commenced. She now complained of some pain in both sides of the neck, and the cervical glands were tender and slightly enlarged; also the pain in the right inguinal glands persisted. At 10 P. M. the patient was very restless; temperature 105; labour was progressing normally. At 10-50 P. M. labour was completed normally. There was no unusual hæmorrhage, merely the average loss of blood. Patient was much exhausted, temperature 102, pulse 140, respiration 72 per minute, with considerable dyspnœa. The temperature gradually rose to 104, and there was much prostration, dyspnœa and cardiac failure.

17th, patient died at 7-55 A. M. The child was 18 inches in length and weighed 4 lbs., and although small, it was fully developed. It remained perfectly well, throve, and after 20 days was sent to a foundling home. When last heard of on June 1st, it was still in good health. It never showed the slightest sign of plague or of any illness whatever.

Post-mortem examination of the mother was made three hours after death. Body well nourished, no petechiæ on skin, hæmorrhages under conjunctivæ, rigor mortis present.

Heart.—Petechiæ under visceral and parietal pericardium; heart-muscle looked firm; there were *post-mortem* clots in the cavities and in the aorta.

Vena Cava.—Great engorgement of its coats and many hæmorrhages under the inner coat, giving it a mottled appearance; these were seen in the abdominal vena cava as well.

Lungs.—Intense engorgement and œdema; there was one small round patch of early pneumonia at the back of the left lung, it was light red and fairly solid, with recent pleurisy over it. There were small hæmorrhages under both pleuræ. Bronchial mucous membrane much engorged, purple and swollen; the tubes contained frothy watery fluid, but no pus.

Liver.—A little large, its substance rather pale and soft and much engorgement of vessels.

Spleen.—Rather large and soft, of purple colour and engorged; the Malpighian bodies were prominent and appeared to be engorged.

Kidney.—Hæmorrhages under capsule, engorgement of vessels, the kidney substance pale and soft. There were hæmorrhages in the pelvis and calices and the whole ureter was purple red with distinct hæmorrhages under its inner coat.

The bladder contained urine, and there were hæmorrhages into its mucous coat.

Uterus.—Large, as of a woman recently delivered. There was much recent clot in its cavity of the normal appearance, and a well marked corpus luteum in the left ovary. All the generative organs looked normal.

Peritoneum.—Considerable engorgement and large hæmorrhages in the retro-peritoneal tissue, mostly in the lumbar regions.

Brain.—Hæmorrhages under scalp and beneath periosteum on surface of cranium; cerebral membranes engorged, with puncta cruenta in brain distinct; no excess of fluid in ventricles; brain-substance looked normal.

Lymphatic Glands. Inguinal, on both sides, some as large as beans, and some smaller, engorged, light red in colour and œdematous, but some of the upper ones were flatter and more normal-looking.

Iliac, right side, the lowest was like an almond, deeply engorged and rather soft, the upper ones were smaller and paler. Left side, lowest like a large bean, and the other, smaller.

Lumbar, rather large and a little engorged.

Mesenteric, slightly swollen and engorged.

Bronchial, of normal size, slightly engorged.

Axillary, in size from hazel-nuts to peas, dusky red, œdematous and much engorged.

Cervical, as large as hazel-nuts, deeply engorged and œdematous, and some with a little hæmorrhage into the surrounding connective tissue.

Supra-trochlear, as large as peas and engorged.

Alimentary System.—Tonsils small, slightly engorged, œsophagus rather engorged but no hæmorrhages in its walls; there were distinct petechiæ in the stomach, a few in the small intestine, and more in the colon and rectum; all these parts being likewise engorged. The sub-maxillary and parotid salivary glands and the pancreas were slightly engorged.

The Breast looked normal and contained good secretion of normal-looking milk, and its vessels were rather full of blood.

Under the microscope plague-bacilli in large numbers were seen in the inguinal, cervical and axillary glands: they were also present in the blood to a considerable extent.

This account of the pathology of plague is based upon fifty complete autopsies, of which twelve were examples of the pneumonic type. Sections for the microscope of the various lymphatic glands and organs were made in twenty-three of the cases, and from these the minute anatomy has been described. Further, in all the cases, many specimens were prepared to show the distribution of the plague-bacillus in the various parts of the body, and cultures were made as well in nearly every instance. As the results obtained from cultures have not been stated above in the *post-mortem* descriptions, it will be convenient to group them together here. By the method of cultivation the plague-bacillus has been isolated from the following organs and secretions;—from the bubo, and, in septicæmic cases, from plague glands in the various regions (*e.g.*, in one case from the inguinal, iliac, axillary and cervical glands); from the lung, liver, spleen and kidney; from the blood and urine. In one instance the plague-bacillus was proved by Dr. Bitter to be present in the mucus obtained from the large intestine. In cases of plague pneumonia the bacillus could be isolated from the sputum during life, from the fluid contained in the trachea and bronchi after death, from the pneumonic patches and in several instances from the bronchial glands.

IV.—MODE OF EXIT OF THE PLAGUE-BACILLUS FROM THE BODY.

From consideration of the *post-mortem* appearances it is seen that engorgement and hæmorrhage are marked features of plague, and further that hæmorrhage is constantly found on the surface of mucous membranes; consequently, as soon as the bacillus has entered the blood of the general circulation, it is possible for it to escape from the body in the hæmorrhages on mucous surfaces. Thus in the urinary system blood may be found in the urine during life, and after death in the tubules and pelvis of the kidney; and besides, there may be extravasations on the surface of the ureter and bladder; hence by the urine there is a direct route for the bacillus to leave the body.

Again in the alimentary system, petechiæ are nearly always present in the stomach, and as vomiting is a very constant symptom of plague, the bacillus may escape in the vomit; similarly petechiæ are generally found in the colon and rectum, and hence the bacillus may escape in the fæces. As for the respiratory system, blood may be found in the alveoli of the lungs in ordinary cases of plague, whilst in cases of the pneumonic type it is invariably present; besides in those latter cases the bacillus is present in enormous numbers in the pneumonic patches and in the sputum, and it is extremely probable that plague-pneumonia for this reason plays an important part in spreading the disease. (In the preceding section the secretions have been named from which the plague-bacillus was isolated by the method of cultures.) With regard to the bubo itself, in certain cases it suppurates, and it would seem possible for the bacillus to escape in the pus; but this was not found to be the case, for in several instances where cultures were made from the pus, no growth of the plague-bacillus was obtained. It remains to make a remark about the presence of the bacillus in the blood. In a number of *early* plague cases which will be detailed hereafter, cultures were made from the finger-blood, but the bacillus could not be isolated from them, in fact they all remained sterile; whereas in fatal cases the bacillus could always be grown from the blood after death, even when the *post-mortem* was made one hour after death, and in one instance it was grown from the finger-blood twenty-four hours before death. Hence one may say that at least in fatal cases, which form the large majority in this disease, the bacillus is present in the blood for a certain time before death, and is able to leave the body in the various secretions which contain blood.

V.—MODE OF ENTRANCE OF THE PLAGUE-BACILLUS INTO THE BODY.

Having regard to the fact that the initial bubo in plague is usually situated in the glands of the extremities, especially the inguinal and axillary chains, it appears probable that the bacillus may enter the body through a lesion of the skin—preferably of the extremities—and thence travel upwards to the nearest group of lymphatic glands and thus form the bubo. In order to test this theory a large number of plague cases were examined to see if any primary lesion in the skin could be discovered through which the bacillus had entered; and as the patients mostly belonged to the lower classes, who commonly go bare-footed and bare-legged, it was usual to find cracks and abrasions about the feet, and also about the hands, the latter resulting from occupation. Further, as various parasitic skin diseases, such as ringworm and itch, are very common among these people, it will be seen that there are many opportunities for the bacillus to enter the body through the skin.

Bearing in mind the analogy of anthrax and syphilis, the skin was examined to see if any characteristic lesion was similarly present in plague. No such definite lesion was found, but in certain cases the bacillus was proved to be present in a particular lesion on the skin and as in each instance the bubo was situated in the glands corresponding to the lesion, this place was believed to be the point of entrance of the bacillus. There was nothing characteristic about the lesion. It was usually a small ordinary-looking papule on a slightly inflamed base, with a little serum at its apex and partly covered by scab. In some cases a hair was found growing through its centre, and it seemed to be merely an inflamed hair-follicle which had been scratched. These cases will now be given in detail.

B., *Hindu man*, age 40, came to hospital on 5th October 1896. Three days ago he was seized with fever and shortly afterwards found pain and swelling in the left axilla. On admission he looked very ill, temperature 103, and there was a large bubo in the left axilla. On the outer side of the left forearm near the wrist there was a small papule the size of a pea, with a hair growing through it; it was slightly red at the base, contained a little serum at the apex and was partly covered by a scab. It was not painful, and the patient knew nothing about it; there were no inflamed lymphatics leading from it. Cultivations were made from the serum squeezed from the papule, and a typical growth of plague was obtained. Part of the culture was injected into a rat, and the rat died of plague after 60 hours. On the same date, 5th October, cultures were made from the finger blood, but all remained sterile. This man died on 8th October.

N. S., *Hindu man*, aged 28, came to hospital December 1st, 1896. There was a large bubo in the vertical set of the right inguinal glands. He said he had been ill three days. There were many old cracks and fissures about the feet and toes, the skin being thick and horny, and some scratch marks on both legs. On the outer surface of the right calf there was a slightly raised œdematous portion of skin about one inch long, and on it there was a small bleb, the size of a large pin's head. From the bleb some thin serum was squeezed out. Cultures were made from the fluid in the bleb and from the finger blood. A pure growth of the plague-bacillus was ultimately obtained from the bleb, whereas the cultures of the blood remained sterile. In this case too, the patient could give no history of the œdematous patch on the leg, and there was no pain in it.

N., *Hindu man*, aged 30 years, was admitted on March 3rd, 1897, with a bubo at the back part of the right axilla. He had been ill two days. On the back, near the angle of the right scapula, there was a papule, the size of a pea, on a slightly-reddened base and partly scabbed over; it looked like a pimple which had been scratched. Cultures were made from the serum squeezed from this papule and from the finger-blood; pure growth of the plague-bacillus was ultimately obtained from the papule, but the cultures of the finger-blood remained sterile.

P., *Hindu boy*, aged 16, admitted on October 26th, 1896. On either side several of the oblique inguinal glands were enlarged to the size of walnuts, and painful. There was a small unopened papule on the glands penis exactly in the dorsal middle line; its apex contained a little pus and serum. It did not look at all like a chancre, and the boy said he knew nothing about it. Cultures were made from the papule and from the finger-blood. From the former a pure growth of plague was ultimately obtained. This was injected into a rat, and the rat died of plague. Cultures of the finger-blood remained sterile. This patient recovered.

As confirmatory of the above observations, I may quote as follows from "A report on the Epidemic of Bubonic Plague at Hong-Kong in the year 1896" by Staff Surgeon Wilm of the Imperial German Navy:—"As regards infection through the skin, two incontestible cases were observed in the epidemic of 1894. Two Japanese physicians were infected, while making *post-mortem* examinations and were attacked a few days later by plague. They had axillary buboes and lymphangitis of the arm, which spread upwards from the small inflamed wounds of the fingers."

The above are the four cases in which the plague-bacillus was found in a certain definite situation on the skin, and this place was believed to be the seat of inoculation of the disease; moreover, in each instance the corresponding proximal glands formed the bubo, and there was nothing characteristic about the skin lesion. It looked like an ordinary pimple which had been rubbed or scratched, and no local reaction had occurred in it, due to the presence of the bacillus; also, it was not painful and the patient was unaware of its existence. It may be stated here that in a large number of other patients small papules or abrasions were similarly examined, but the plague-bacillus was not proved to be present. Thus, in one instance a man had acne extensively on the face and a bubo in the left cervical region; in another, three small scabbed wounds on the right foot with a bubo in the vertical right inguinal glands; in a third, a number of papules on the left arm with a left axillary bubo, and other cases could be quoted. Some of the papules were examined in these cases but with a negative result. A point remains to be noticed; it may be objected that if the bacillus were already in the blood, it could pass with the serum into a papule wherever situated, and its presence there would be the result, and not the cause, of the disease. But against this view there are the facts, 1st, that in the above four cases, which were all early, the bacillus could not be isolated from the blood on the same day that it was found in the papule; and 2nd, that in a number of other early cases pimples situated in various parts of the body were examined, not only on the limb corresponding to the bubo, but the bacillus was not found in them. Also in three early cases of inguinal bubo, a small blister was raised upon the chest, but the plague-bacillus could not be isolated from the contained serum.

The conclusion drawn is, that the bacillus of plague can enter the body through a trifling lesion in the skin, that it produces no local reaction at the seat of inoculation, and that the bubo is formed at the nearest proximal glands.

With regard to infection by food, no evidence was found *post-mortem* that the bacillus had entered through the stomach or intestines; but cases of cervical bubo might have resulted from infection through abrasions on the lips, tongue or tonsils.

As for the cases of primary plague-pneumonia, no evidence of the path of infection was found, but the bacillus was thought to have entered by the respiratory tract, as its growth had mainly occurred in the lungs.

APPENDIX A.

On the clinical aspect of Plague-Pneumonia.

When plague appeared in Bombay, and as the disease developed, one was struck by the following facts:—First, in all published accounts of the disease, although the ordinary phase of the malady, *viz.*, plague with buboes, is principally described, still mention is always made of another and more fatal form without buboes; whereas here in Bombay it seemed as if the bubonic form were alone appearing, for at the beginning one saw no examples of the other form. Then one observed that coincidently with the increased death-rate due to plague, there was a large and unexplained increase assigned to remittent fever and respiratory diseases. Week by week as the plague mortality increased, so did that under these two headings, and though it was possible that all these were cases of known but concealed plague, still one could not help suspecting that some of them might be due to plague which was not diagnosed because of the absence of buboes. So I resolved to examine the bodies of all hospital patients who had died of fever, pneumonia or any acute illness, to see if there were evidence that any of them had really died of plague. And at the end of December I met with a case which had been diagnosed as broncho-pneumonia, but which turned out to be one of plague affecting the lungs, without causing any marked enlargement of the lymphatic glands—a case, in fact, of plague-pneumonia; and as this *post-mortem* is exactly like many others that I have since made, and is typical of the disease, I will give a few notes of it.

B. L., Hindu, male, 25 years old, admitted for fever and cough, December 26th, 1896, under Dr. S. He said he had been ill for about seven days. He had symptoms in the chest which led to the diagnosis of broncho-pneumonia being made. No lymphatic glands were found to be enlarged or painful, and a specimen of blood taken by Dr. S. shewed no plague-bacilli under the microscope. He coughed up about two ounces of blood-stained fluid on the night of the 27th, and died at 3 A.M. on December 28th.

Post-mortem on December 28th, seven hours after death.

Lungs.—Much general engorgement and œdema, with sero-sanguineous frothy fluid in the bronchi, but no pus; and the usual appearances of the acute bronchitis were absent. There was one small pneumonic patch, the size of a walnut, in the early second stage, situated a little below the apex on the front of the right lung, and two similar but smaller patches at about the same part of the left lung. These patches stood out a little from the surface and were light grey in colour, airless, friable and sank in water; and each was surrounded by a dark ring of engorged lung in the first stage of pneumonia, which merged into healthy lung; there was some recent pleurisy over the pneumonic areas. All the other organs were examined and showed considerable engorgement, but no special lesion was observed.

Condition of the Lymphatic Glands.—The bronchia were quite small and of normal appearance; the cervical were slightly enlarged, but pale and not engorged; the axillary were pink and slightly enlarged; the left iliac were somewhat large, red and soft, the lumbar were swollen but pale; and all the other glands looked absolutely normal.

Cultures were made on agar-agar from the pneumonic lung and spleen, and ultimately a pure growth of the plague-bacillus was obtained from each.

Microscope.—The pneumonic patches in both stages showed an immense number of plague-bacilli, and the rest of the lung showed a large number, the left supra-trochlear and the left femoral glands shewed a fair number, and all the other glands, extremely few; the spleen and blood also showed a few.

So this was a case of plague, in which during life all the symptoms pointed to disease of the lungs, and in which there were no evidences of glandular enlargement, whilst after death there was clear proof of enormous growth of plague-bacilli in the lungs, and of only very slight growth in the lymphatic glands.

I have made up to the present twelve *post-mortems* on such cases, all presenting appearances similar to the above; and I may add that all the patients were brought to hospital by their friends, supposed to be suffering from cough and fever, and, as far as I know, they were quite unaware of the nature of the disease. I have also to say that in nearly all the other cases the fluid from the trachea or bronchial tubes has also been examined; it shows an immense number of plague-bacilli, and cultures of plague can always be obtained from it. With regard to the clinical symptoms of these cases, it fell to me to attend on the late Dr. Manser, and as he died of this form of plague, I will mention a few facts about his case. He was in his usual health on January 2nd, and had a sudden rigor in the morning and felt fever coming on. During the day a bad headache developed, he felt nausea and vomited several times, and he had pains and a tired feeling in his limbs; his tongue remained clean and moist, and his skin was slightly moist. At 2 P.M., temperature 103·4, pulse 116, respiration 25, and there were but slight variations during the day. On January 3rd, had passed a bad night and felt worse, and all the symptoms persisted, except the aching in the limbs, and he felt very ill. The temperature remained between 103·5 and 104·5, pulse about 110, and respirations about 23 throughout the day. During the afternoon he felt some pain at the lower part of the left axilla just under the anterior fold, but there was no glandular enlargement or pain in the glands anywhere. On January 4th, had passed a bad night and felt very ill, temperature 104·6, pulse 113, respiration 25, tongue still moist, with a little fur behind, and no sores about the lips or teeth; the other symptoms as before. During the night he began to cough and brought up some watery sero-mucous fluid, slightly blood-tinged, and the pain remained in the same place, only more diffused now, being felt over an area of a square inch. At this part some moist sounds could be heard like those of early pneumonia, and they could also be heard just below the left clavicle; the rest of the lungs and other organs appeared to be normal, as did the lymphatic glands. Patient considered that he had pneumonia, but the symptoms were not like ordinary pneumonia.

For the onset was different, the condition of the tongue and mouth different, there was no dyspnœa or pneumonic disproportion of pulse and respiration, and the sputum was not at all like rusty sputum; for it was loose and free, coming up with the slightest cough, it was watery, looking more like serum than mucus, and it was slightly pink, not rusty yellow at all. Also there was the striking fact that the patient's general condition was far worse than could be explained by the small amount of lung-disease present.

So I examined the sputum under the microscope, and found it full of bacilli looking like those of plague, and cultures were made from which a pure growth of the plague-bacillus was obtained. During the 4th and 5th, patient became steadily worse, his temperature remained about 104, and his expectoration became most profuse; the moist sounds were heard over a larger area as well as slightly at the bases; the respirations increased to 35, and then to 45, and the pulse to 120 and 135; and he ultimately died early on January 6th.

There is also the case of the nurse who attended him, who unfortunately died of a similar form of plague. In brief she became ill on the evening of January 7th, and showed symptoms of pneumonia on January 8th. She rapidly became worse and died on the 10th, but her sputum was not nearly so profuse as in the former case, and symptoms of exhaustion came on much earlier. She also had no glandular pain or enlargement whatever, and bacteriologically her sputum was exactly as described above. Other cases were met with in which, besides plague-pneumonia, there was also general enlargement of the glands,—plague-septicæmia; and clinically it was found that either the pneumonia was primary, and the glandular enlargement secondary, or that the disease first showed itself in the glands and later on in the lungs; and whilst some of the latter recovered, the former were usually rapidly fatal. Also the sputum was not always as has been described above, for in some cases the presence of blood in it was a marked feature, and it was either moderate or abundant in quantity. These pneumonic forms of plague are highly infectious and probably take a large share in the spread of the disease; for in these cases the patient's sputum is practically a virulent pure culture of the plague-bacillus, and as there is reason to believe that many of the cases are not recognised as plague at all, precautions are not taken by the patients' friends, and the dangerous nature of the disease is not appreciated. I have no means of knowing how frequent this variety of plague has been in the present epidemic, but there is some evidence to show that a considerable number of cases have occurred. Moreover, it seems likely that a ship's passenger suffering from this form of plague might escape detection by sanitary officers, and might be permitted to land at his destination as though he were the subject of simple pneumonia; and so a centre of infection for the spread of plague would be established. With regard to the literature on this subject, I have not been able to find a published description of this variety of plague; but an allusion to it is made in the accounts of the Pali epidemic of 1836, and it is stated that the Astrakhan outbreak of 1877 was first regarded as croupous pneumonia or as typhus complicated by pneumonia; from the reports on the Hongkong epidemic it appears that plague-pneumonia did not occur there. There is just this to add: the usual definition of plague in works on medicine is—"A specific fever attended by bubo of the inguinal or other glands," but it is clear that such a form of words does not include all varieties of the disease. (This paper was read before a meeting of the Bombay Medical and Physical Society on April 2nd 1897.)

APPENDIX B.

On the occurrence of involution forms of the Plague Bacillus in the human body.

In January last Mons. Haffkine shewed me involution forms of the bacillus which he had found in a rabbit dead of plague, and he suggested that I should examine human bodies to see if similar forms could be found. Accordingly in many instances a large number of lymphatic glands and other organs were examined and involution forms were frequently present. The forms seen were mostly of the rounded or swollen oval shape, and always stained more faintly than the young early bacilli. This investigation was made for the following reason. In cultures of plague, as the culture becomes old, involution forms begin to appear, and the older the culture, within limits, the more distinct are the involution forms. So it was thought possible that a similar condition of affairs might be found in the human body, and that most involution forms would be present in that part where the bacilli had been longest situated, that is, where they had first begun to grow: thus, in a case of plague-septicæmia, for example, if most involutions were found in some particular gland, one might infer that the bacilli had first infected and grown in this gland. The enquiry, however, did not bear out this theory, for it was found that the involution forms had a direct reference to the period after death at which the autopsy was made, and in fact they appeared to be a *post-mortem* change. Thus, in autopsies made between one and five hours after death, the plague-bacilli always shewed a distinct well-stained normal form; in those made between five and ten hours after death early involution forms were seen, rounded in shape and less distinctly stained; whereas in the few *post-mortems* made more than ten hours after death involution forms were plainly seen of rounded and oval shapes and still more faintly stained. It may also be noted that in cases of plague-septicæmia some glands shewed more involution forms than others, but the variations followed no rule, and no conclusions could be deduced from them.

APPENDIX C.

Case of Plague with a Carbuncle.

R. B., *Hindu*, aged 30, admitted on 24th December 1896, looking very ill. There is a large mass looking like a carbuncle situated over the hepatic region and towards the right axilla; it is round, four inches in diameter and half an inch above the skin level. It has a red ulcerated surface with beads of reddish serum exuding from it at various points, and there is no skin remaining on it. There is a large mass of glands in the right axilla with effusion around them, the whole filling out the axilla and having the usual appearance of a plague-bubo; glands can also be felt in the left axilla and both groins, but they are only a little enlarged and are not buboes. Patient states that the ulcerated mass began fifteen days age as a small boil or pimple; some native ointment was applied to it, and then it increased and reached its present size. Four days before admission he felt a painful swelling in the right axilla, which has since increased to its present condition, and during this time he says he has had high fever.

Cultures were made from the bubo in the right axilla, and a pure growth of plague was obtained from them.

This patient was very ill and there was no means of ascertaining the truth of the history he gave. But if it was true that the first symptoms of plague had shown themselves in the formation of the right axillary bubo four days before admission, it seemed likely that infection had occurred through the carbuncle.

I have to express my thanks to Professor Bitter, Director of the Institute of Hygiene, Cairo, to Mons. Haffkine, C.I.E., and to Mr. Hankin for assistance in this research; and also to Dr. A. C. Viegas for showing me cases of plague immediately after he had discovered the existence of the disease in Bombay in September 1896.

L. F. CHILDE, Surgeon-Captain, I.M.S.

20th October 1897.

APPENDIX No. XIV.

REPORT ON PLAGUE

BY

SURGEON-MAJOR LYONS, I.M.S., PRESIDENT OF THE PLAGUE RESEARCH COMMITTEE.

The Plague Research Committee was originally formed, under Government Resolution, General Department, No. 4533, dated 13th October 1896, to inquire into the natureand history of the disease, stated to be bubonic plague, of which a number of cases had occurred in Bombay City.

Surgeon-Major R. Manser, *President.*
Surgeon-Captain L. F. Childe.
Dr. Nusservanji Fakirji Surveyor.
Dr. W. M. Haffkine.
Mr. E. H. Hankin.

The Committee was composed as per margin, and the members decided to distribute the work among them as follows:—

Surgeon-Major Manser:—The clinical aspect of the disease; its treatment by drugs; the source of the Bombay outbreak; the history of its introduction and spread; and the evidence relating to its incubation period.

Surgeon-Captain Childe:—The macroscopic and microscopic pathology of the disease.

Mr. Hankin:—Its origin in the outside world; search for the microbe in food, clothing, bedding, drains and sea-water; and whether the microbes survived longer in rotten than in sound grain.

Dr. Surveyor:—The nature of the disease in rats and fowls; bacteriological proof that rats are suffering from the disease; the effects of antiseptics on the microbe; and the relative value of different antiseptics practically.

Dr. Haffkine:—The study of the microbe and its relation to the patient and to the animal body; the question of its communicability by infection or contagion between man and man, and between man and animals, inoculations, etc.; diagnostic methods; the period during which the patient continues infectious; immunity; and antitoxine and other treatment.

Surgeon-Major Manser contracted plague from which he died on 6th January 1897, and his place on the Committee was taken by me on the 25th January 1897.

Dr. Surveyor has been unable, owing to illness, to pursue his line of investigation or to write a report.

The reports of the other members, with the exception of that of Dr. Haffkine, are submitted herewith in full detail. Owing to the pressure of laboratory work, in which he is still engaged, Dr. Haffkine has not yet been able to arrange the material he has collected in the form of a report. Such suggestions as have been submitted by the Committee will be found in the General Appendix.[*]

The members of the Committee have in addition examined and reported on a very large number of specimens from suspected plague cases sent from every part of India; experimented with numerous antiseptics sent for report; and answered an immense number of inquiries addressed to them; involving tedious laboratory work and a considerable amount of correspondence.

The difficulties of laboratory research were very great owing to want of apparatus and of trained and intelligent assistants to carry out the ordinary routine work.

The portions of the programme which devolved on Surgeon-Captain Childe, and myself had to be carried out at such times as we could spare from our other duties, which, owing to the presence of the epidemic, were unusually heavy.

In the present outbreak of plague the infection was no doubt imported from some locality in which the disease existed, but the most searching inquiry, instituted at the time it was first noticed, failed to discover evidence of plague cases (or indeed of any severe form of sickness except twelve cases of cholera) on board vessels which entered Bombay Harbour after 1st June 1896.

Inquiry was also instituted among ship-owners regarding any noticeable mortality among rats on ships trading with China and ports where plague was known to have existed, but in this case also with negative results. As the outbreak commenced near the Docks, it appears most probable that the infection was introduced by sea and carried in their clothes or goods by traders[†] who were themselves insusceptible. It is also possible that it may have been introduced in this way by traders from Northern India, as plague is believed to be endemic on the southern slopes of the Himalayas.

The disease probably commenced to spread in Bombay about the beginning of August 1896, as the mortality of the city began to increase in the second week of that month (*vide* Table VII). This increase in mortality was attributed at the time to remittent fever and lung affections, but as rats were dying in great numbers in Mandvi Ward, where the death-rate among the population was unusually high and where the prevalence of the epidemic was first discovered, there can be little doubt that the excessive mortality was due to plague. The epidemic spread slowly, and the total mortality continued to increase until by the second week in February the whole city had become infected. After that time the mortality began to decrease, and by the end of May it had fallen to the normal, and deaths from plague ceased to occur.

The official returns of deaths from plague are for various reasons not very accurate. A fairly correct estimate of the mortality can be obtained, however, by taking as plague mortality the difference between the weekly mortality and the mean of the corresponding weeks during the preceding five years (*vide* Table VII), as there was no other unusual cause of sickness present.

It must be remembered that the average weekly mortality during the preceding five years is taken on a population of 800,000, and that, owing to the exodus which occurred after the outbreak of the epidemic, the population was reduced by from a fourth to a third of that number. The true incidence of the disease was consequently considerably heavier during the later weeks than shown in the table, and this error is a gradually increasing one growing with the decrease of the population.

It has been stated that in other places outbreaks were often preceded by the appearance of cases of painless buboes unaccompanied by vomiting, fever, headache or other symptoms of plague, but this was not observed in Bombay.

It may here be noted that the great difficulty which arises in tracing the mode of infection and the course of plague as compared with the other more common infectious diseases, is due to two facts—*viz.*, that animals such as rats readily contract and afterwards spread the disease, and that the microbe is capable of thriving and multiplying outside the animal body, as is seen, for example, when it is cultivated in broth or on *ghee*. It is evident that infection may be carried by rats to persons who have never been brought into contact with plague patients, nor with persons visiting plague patients, and whose food and clothing could not have been contaminated in any other way. On the other hand, the germs may be conveyed by persons who are themselves insusceptible to plague, and, having grown and multiplied on suitable media and under favourable conditions, may infect large numbers of people who have never come into contact with plague patients, their attendants or plague-stricken rats.

The development of plague in an epidemic form was believed by many persons to be due to rotten grain which had been buried under ground, and it was thought by some infected with plague germs. Had rotten or diseased grain been sold as food (and there was no evidence that this took place), it would in all probability have given rise to digestive disorders, and in so far have predisposed to plague: but if the grain had been infected with plague bacilli, the disease would have appeared in several localities simultaneously, wherever the infected grain had been eaten. It is impossible to believe, too, that large stores of infected grain could have been sold without giving rise to an outbreak of disease among grain-sellers throughout Bombay. It is well known that this spreading of the disease far and wide among grain-dealers did not occur, and the 54 grain and flour sellers,

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Not published with the Proceedings of the Commission.

[†] Dr. Jan Mahomed's first cases occurred towards the end of September among Mooltanis who trade with China, and who lived near the docks.

millers and grain-parchers who died from plague between the months of September 1896, and January 1897, died principally in infected localities in the neighbourhood of the Docks where the disease first appeared, but did not themselves form centres from which the disease spread in unaffected districts.

The epidemic was observed to increase notably during the cold season and to decline during the hot weather (*vide* Table II.). This increase during the cold months was probably due, to a great extent, to the sick and healthy occupying the same rooms during the day and sleeping together at night, and also to the depressing effects of cold. During the warm months the poor live under much more sanitary conditions than in the cold season.

The influence of animals in spreading the disease was, with the exception of rats, probably inappreciable. A searching inquiry at Damaun, where there were great numbers of pigs at large in the streets, elicited no evidence of a single death, or even of an appearance of sickness among pigs, although an exceptionally severe epidemic of plague had visited the town. Sheep, goats, horses and cows were unaffected. There was evidence (*post-mortem*) of a dog having been affected, but none that cats contracted the disease. Birds were not at all affected.

In the epidemic at present going on at Hardwar, monkeys are infected and dying in considerable numbers. The grey monkey is very susceptible to plague and rarely recovers, the brown monkey is much less severely affected.

The influence of ants and bugs in spreading the disease is considered by Mr. Hankin to be unimportant.

An alluvial soil, situated at a low level, copiously watered, associated with a high degree of atmospheric moisture and a temperature of 80° F. (conditions which are fulfilled by seaports like Bombay) are generally looked upon as those most favourable for the development of plague to epidemic proportions. But as far as can be judged, the Bombay outbreak, where these conditions obtained, was certainly no more severe than that which has since occurred at Kirkee. In the latter place the soil is of laterite and well drained, and the cantonment has a high situation, a small rainfall and a dry atmosphere.

All observers up to the present time have connected the occurrence and diffusion of the disease with want and filth, and there seems to be no doubt that these factors do favour it, in so far as they lower the general health and diminish natural immunity. But it will be seen that filth *per se* has but little influence, from the fact that there occurred in the House of Correction, Byculla, where cleanliness is brought as nearly to perfection as is attainable, an outbreak which exceeded in severity that in any of the filthy chawls and tenements around. There were 345 prisoners confined in this jail when plague broke out there on the 23rd January 1897, the outbreak lasted for 15 days, and in that time 33 prisoners were attacked, 17 of whom died. It is a significant fact, too, in this connection that out of 1,579 patients treated at the Arthur Road and Parel Hospitals there were only 16 sweepers, and that the halalcores who remove the night-soil from the houses, and who form probably the dirtiest portion of the population, were notably free from plague. It is true they are a strong well-nourished class, of whom only the fittest have survived, and they are highly paid and live well.

The predisposing causes were mainly those leading to a lower state of vitality, and which consequently lessened the natural resistance of the individual to infection. In this way, as abovementioned, the long-continued and exceptionally hot season of 1896, the unusually heavy rainfall which followed and which confined the poor constantly in their overcrowded and insanitary dwellings, and the great heat which succeeded the rains, were powerful factors in lowering vitality. Then came scarcity due to dearness of food. During the cold season the unhealthy condition of chawls (native flats) and houses in the city was rendered worse by overcrowding, the inmates being unable to sleep and work in the open, as large numbers of them are accustomed to do during the warmer months. Indeed, the effect of cold alone on the feeble and on those who are insufficiently clothed, as already mentioned, is a powerful factor in lessening resistance to infection.

The largest number of admissions into hospital occurred between the ages of 20 and 30 years. At the Arthur Road Hospital, Bombay, out of 1,275 admissions, 445 or 34·9% occurred between the ages of 20 and 30 years; 291 or 22·8% between 10 and 20 years; and 255 or 20°/o between 30 and 40 years.

In the Poona Plague Hospital out of 1,130 admissions, 263 or 23·27% occurred between the ages of 20 and 30; 137 or 20·97°/o between the ages of 10 and 20 years, and 197 or 17·43°/o between the ages of 30 and 40.

A constant source of error in these statistics is that the ages of those admitted are seldom or never exactly known, consequently those given are only approximate. Another source of error is that in young children death from plague frequently occurs before the nature of the disease is recognised; so they are not admitted into the plague hospitals. In the case of children, however, the very small number of admissions (*vide* Tables I. and II.) is no doubt partly due to the smaller number exposed to infection, as the exodus which took place on the outbreak of the epidemic was very largely confined to women and children. The withdrawal of the women gave rise to a marked decrease (*vide* Table VII.) in the birth-rate of the city, which during the ten months under review fell below the mean of the preceding five years for the same period by 3,685.

That young adults should give the highest number of admissions is not surprising, as they form the largest proportion of the population, and they travel about more, and so are brought more frequently into contact with the disease. The greatest number of admissions into hospital occurred among domestic (cooks, hamals, massalchis) and personal servants, (*vide* Table V.) who formed 20·88°/o; mill-hands came next forming 11·53°/o; coolies 8·8°/o. The comparatively large number of dhobies (native washermen), dirzis (tailors), gowlies (milkmen) and hajams (barbers) deserves notice, as from their occupation they are likely to spread the disease. The large percentage of admissions among domestic servants is doubtless due to the disease being detected early, and to their masters seeing that they were taken to hospital.*

It is impossible to estimate the influence of race and caste on susceptibility to plague, owing to Europeans living under very different sanitary conditions from natives, and to the effect of social position in altering the conditions obtaining among natives themselves; besides, correct statistics cannot be obtained as to the native population present during the epidemic and the numbers attacked by plague.

That more males than females were attacked (*vide* Table IV.) is probably entirely owing to the former having been present in large number.

The exciting cause of plague is the plague bacillus of Kitasato, which is believed to gain admission to the body, usually through an abrasion of the skin, or more rarely of a mucous surface. In a number of instances in the present epidemic points of inoculation were found on the extremities of plague patients, from which plague cultures were obtained, and in these cases buboes were found above the point of inoculation. In the majority of instances however no local indication could be found marking the point at which the microbe was implanted. Less frequently infection is believed to have occurred in the respiratory organs or in the digestive tract. When the disease appears in the form of primary plague pneumonia, it may be caused by the inhalation of bacilli disseminated in the air by patients as they cough or it may be carried by the blood vessels, or lymphatic vessels to the lungs, where it developes.

When a monkey is inoculated by pricking its hand with a needle dipped in plague culture, the slight wound made disappears in a couple of days, and leaves no indication of the point at which inoculation was performed. After 4 or 5 days a bubo appears in the axilla or at the bend of the elbow, and the symptoms of plague develop. The lymph from the bubo in these cases contains plague bacilli in great numbers, from which cultures can be made. In the case of man also, as already mentioned, the point at which inoculation occurred was but rarely discovered. Plague bacilli could however be obtained in immense numbers, and cultures made, from lymph taken from buboes. In septicæmic cases they could be obtained from the blood as well as from lymph from enlarged glands; and in pneumonic cases they were obtainable from the sputa and from enlarged glands when present. Bacilli were probably also present as a rule in the sputa, vomit, urine and fæces of plague patients, but they were hardly ever found in the blood taken from the finger in cases where a bubo was present from the first.

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* For the purpose of comparison, it was intended to have also given a statement showing the number of deaths from plague in Bombay City according to occupation (Table VI.), but information could only be obtained up to 31st December 1896.

The slow spread of plague and the immunity observed among hospital servants, nurses and medical men who were in constant contact with the disease, handling the sick, and making *post-mortem* examinations, indicates that the germs produced in the bodies of the sick are but little infectious to healthy persons under ordinary circumstances. The conditions under which they become virulent will only be known when the life history of the microbe outside the body has been traced. Infection occurred most frequently among those living in the same rooms with, and in constant attendance on, the sick, and there can be little doubt but that among the poor and ignorant it was often due to the common custom which exists of friends receiving the sputa of the sick in their hands,[*] and using their hands and clothing to wipe away discharges from the patient's mouth. It is easy to understand also that want of personal cleanliness among the friends of those affected, and the neglect of precautions as to the disinfection of clothing soiled by the discharges and excreta of the sick were fruitful sources of infection.

Plague in its epidemic form, as seen in Bombay, is a malignant infectious disease characterized, in the majority of cases, by enlarged and painful lymphatic glands, high fever and great prostration; and is due to the presence in the system of the plague bacillus.

In the Bombay epidemic the period of *incubation* varied in duration from 36 hours, the shortest,[†] to ten days, the longest[‡] recorded, while in the majority of cases the period of incubation appeared to be from four to six days.

No definite history of *premonitory symptoms* could be obtained, the invasion being, as a rule, sudden and marked by severe rigors or by chills. In infants and young children convulsions frequently ushered in the attack. In a small proportion of cases, however, no marked onset was noticed, the patients stating that the disease began with fever, heat of the skin and pains in the limbs. These cases usually ran a mild course ending in recovery.

The symptoms in a typically severe case generally commenced with a well marked rigor, which was followed by fever, accompanied by vomiting, headache and intolerance of light, pain in the epigastrium and frequently also in the back and limbs. Thirst was unusually much complained of. The *temperature* rapidly rose to 104° F. or more, reaching its maximum, often 105° F. or 106° F. on the evening of the second or, more rarely, on the first day; occasionally a remission of 1° F, or sometimes more, occurred during the day, but with no regularity as to time. A well marked fall in temperature of 2° F. to 3° F. or more was frequently noticed on the second or third day, after which the temperature rose again, but seldom to its former height (*vide* Charts III, IV, VII, X, XV, XVII, XVIII, XIX, XX, XXII); a further fall to normal, or subnormal, occurred between the fifth and seventh days (*vide* Charts I, II, III, VIII, XXII). In uncomplicated cases a fall to normal sometimes occurred on the second or third day (*vide* Charts XX, XXVI), and was often attributed to a particular line of treatment when it was really the usual course of the temperature unaffected by the treatment. The occurrence of complications, *e. g.*, the appearance of fresh buboes, secondary pneumonia, etc., gave rise to great irregularity in the course of the temperature (*vide* Charts II, XIV, XX, XXIII, XXVIII).

Nausea and vomiting were met with at the onset in almost every case, and frequently continued for the first day or two. Splitting frontal or general headache was present from the first and continued while the temperature remained high, subsiding with the fall which occurred on the second or third day. Occasionally epistaxis occurred about this time. The countenance was pale; the eyes red and injected with bands of deeper colour at the outer and inner canthi owing to the eyelids remaining constantly unclosed. Sleeplessness was a distressing symptom, and there was often delirium at night. The pulse frequent, 100 or more, and full at the beginning, soon became soft, compressible, and dicrotic, and eventually running, so that it was difficult or impossible to count. The tongue was as a rule very characteristic. At first it was tooth-indented, somewhat swollen, and evenly covered with a thin white fur, except at the tip and edges, where it was clean. Later, it became dry, thickly covered with a yellowish white or brownish white fur, the tip and edges remaining red and irritable. The bowels were almost always constipated at first, but sometimes diarrhœa was present.

Buboes were met with in over three-fourths of the cases, and in about half the number of cases in which buboes were found, the glands of the vertical set in the groin were involved. They were as a rule noticed at the onset of the disease, giving rise to lancinating pain, but in a number of cases were not found until the second or third day. Generally one gland was markedly affected, and two or more adjacent ones less so. The affected glands varied in size from that of a filbert to a walnut, and they were very tender from the first, although often but little swollen. When in the groin the patient kept the thigh well flexed on the abdomen in order to relieve tension. In about two-thirds of the remaining cases the axillary glands were found to be affected, the patient usually lying on his back with the arm held away from the side and kept perfectly still. In the remaining third the glands below the angle of the jaw or of the superficial cervical set were enlarged.

As a rule a bubo appeared only in one region, but sometimes they were found in more than one region, or on both sides of the body. As the disease progressed the glands of the same chain, situated above those first affected, often became enlarged; so that in cases of a femoral bubo the glands lying along the course of the external iliac and common iliac vessel were also found to be enlarged and tender on pressure. A rise in temperature occurred with each fresh gland or group of glands involved.

In cases which proved fatal early the buboes continued hard and very tender to the last; while in more prolonged cases effusion, frequently large in amount, occurred around them giving rise to a doughy or brawny swelling, and often causing œdema of the limb below from pressure on the vessels and nerves.

With the appearance of effusion the buboes usually became less painful. In a few cases where the patient lived long enough, the swelling subsided by resolution, but in the majority of instances suppuration occurred after the seventh or eighth day, the skin over the infiltrated area becoming inflamed. On opening the bubo thin yellowish or sanious pus was evacuated; the skin frequently sloughed eventually, however, leaving an indolent unhealthy ulcer, with ragged, overhanging edges and a greyish sloughing base, on which one or more necrosed lymphatic glands might be seen. Such ulcers usually took weeks to heal and gave rise to large thickened cicatrices. In cases where suppuration did not take place the glands remained hard and indurated long after convalescence was established.

The nervous system was markedly affected in almost every case from the beginning of the fever. The patient complained of extreme feebleness and prostration; in many cases he could only walk with the greatest difficulty, and was sometimes unable even to leave his bed. There was some loss of sensibility to touch, and often the general cutaneous sensibility to pain also seemed impaired, but in a few cases there was marked hyperæsthesia.

Intelligence was generally unaffected at first, but sometimes the patient appeared to be dazed and stupid and totally indifferent to his surroundings. Memory was defective, or he was unequal to making an effort of memory when asked, for example, to give the date of attack, or to state what his symptoms had been. In a number of cases, owing to in-co-ordination of the lingual muscles, there was thickness of speech like that caused by alcoholic poisoning, and this symptom was so characteristic that the attendants in hospital came to look upon it as a certain sign of plague in cases where enlarged glands had not already appeared. Later in the disease dumbness not infrequently occurred from paralysis of the laryngeal muscles. In addition to loss of muscular power in the upper and lower limbs there was tremor and twitching of the muscles of the hands, and in many cases marked loss of co-ordination also, causing clumsiness of movement in the hands, and giving rise to a staggering gait on attempting to walk. As a rule there was loss of expression, owing to relaxation of the facial muscles, giving the patient an apathetic or a stupid look, and masking the approach of death. Occasionally at the beginning of the illness the expression was anxious. In a number of cases cerebral symptoms were present from the commencement of the disease and continued day and night throughout the attack, taking sometimes the form of delirium and at others that of coma. The delirium was of the busy type, like that of delirium tremens, and was often accompanied by illusions terrifying in character, from which the patient tried to escape; among children convulsions frequently took the place of delirium. In cases marked by stupor the mental faculties appeared to be paralysed, the patient lying in a comatose condition, from which he could only be roused with difficulty, if at all. Such cases generally died within the first two days, but sometimes even within 24 hours.

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[*] It seems not improbable that plague cultures grow in the ghee always present under the nails of natives who eat curry with their hands, and that they often infect themselves from the cultures when scratching skin eruptions, etc.

[†] The case of Chinwal Khan reported by Surgeon-Major MacCartie, Health Officer of the Port of Bombay, on the 11th January 1897.

Chinwal Khan was a fireman on the S. S. *Hydaspes* which arrived from Shanghai (an uninfected port) on Thursday, 7th January, and entered dock the same evening. He did not complain of illness during the voyage to Bombay, and was on regular duty up to the evening of the 7th. Probably on that evening and certainly on Friday morning the 8th, he visited the city. On Saturday morning the 9th he complained of fever and pain in the groin, and on examination was found to be suffering from plague. The incubation period in this case was at most 1½ days and may have been only one day.

Nurse Joyce went to attend on Surgeon-Major Manser on the 4th January at his house. She was in good health and had not been near plague cases up to that day. She nursed him from the 4th to the morning of the 6th. She was attacked by plague on the evening of the 7th, and died on the 9th January 1897.

[‡] This period cannot be accepted as finally settled, as the person attacked, a native of Bombay, may have carried the infection with him and infected himself in Poona, where he was attacked ten days after arriving from Bombay and before plague had broken out in Poona.

The respiratory symptoms were hurried breathing and a sense of oppression and tightness across the chest. In most cases congestion of the bases of the lungs occurred early, and was rapidly followed in many instances, particularly during the cold months, by bronchitis, by œdema of the lungs, or by secondary pneumonia. In these cases of secondary pneumonia the expectoration was bronchitic in character and after a short time became profuse and watery, often showing a considerable colouring of blood. These blood stained serous sputa, owing to the patient's clothing becoming reddened by them, sometimes gave rise to the impression that hæmoptysis had occurred. Primary plague pneumonia was also met with, but this form of plague (which was first recognized and described by Surgeon-Captain Childe) during the present epidemic is so important as to require a detailed description.

In connection with the digestive system, the occurrence of vomiting at the onest of the disease, in some instances accompanied by diarrhœa, has been referred to above. In some cases nausea, vomiting and diarrhœa appeared at the onset and persisted throughout the whole course of the attack. The vomited matter was at first bilious in character; afterwards it contained only water and such liquid nourishment as had been taken. Diarrhœa when it occurred was also bilious in character, the motions numbering five or six in twenty-four hours, the stools being always very offensive and sometimes tinged with blood. In a certain proportion of cases there was pain and tenderness in the epigastric region, pain in the back, and abdominal distension, accompanied by enlargement of the liver and spleen. Surgeon-Captain Hojel has recorded a number of cases of this sort in which low nervous symptoms occurred like those met with in enteric fever, and in some of these cases petechiæ were seen on the abdomen and lower part of the thorax somewhat resembling the rash of enteric. After death the lesions found were those of plague; Peyer's patches were found to be slightly raised, œdematous and congested, the solitary follicles were as large as hempseed, but enlargement of the mesenteric glands was absent.

In the circulatory system there was throbbing of the carotids, and the apex beat of the heart could generally be seen at the beginning of the attack. The impulse at the apex was found to be more diffuse than normal, and sometimes a thrill could be felt in the præcordial region. The sounds soon became feeble, the first sound being very much hortened, and the second sound so weak that it frequently ould not be heard at the apex. In one case only, out of a very large number examined, was a murmur present, although in many cases the heart appeared to be dilated. On examining the blood drawn from the finger it was found to coagulate slowly, and the red corpuscles did not tend to run into rouleaux quickly. In cases where the disease had lasted for a few days the number of white corpuscles present was greatly in excess of the normal. In most cases after the first day, and in all cases after two or three days a marked fall in blood pressure occurred; this fall in blood pressure and the great frequency of the heart's action were the most marked circulatory changes observed.

In the urinary system pain was sometimes present in the region of the kidneys. The urine secreted was diminished in quantity, of high specific gravity, and intensely acid in reaction. In colour it was generally brownish yellow, but sometimes it was smoky or red from the presence of blood. Albumen was present in about three-fourths of the cases; urea and uric acid were deficient, and chlorides markedly deficient; casts were generally present. The attached table (Table IX) gives a quantitative urine analysis made by Surg.-Capt. Hojel. It shows the results obtained in fifty plague cases treated at St. George's Hospital. With the exception of No. 19, all the analyses were made between the third and sixth day; all were examined as soon after admission as possible, and the majority for several days in succession. Micturition was frequent in many cases, but no symptoms of scalding were as a rule complained of. In cases which terminated fatally the urine was often retained towards the end.

Where pregnancy was present, the patient, as a rule, aborted on the first or second day after the onset of the disease, but this was not invariably the case. Out of three pregnant cases treated at St. George's Hospital only two aborted, and both recovered; the third (*vide* Chart XXII), two months pregnant, went on to full term. When premature labour occurred, both mother and child usually died. In one case, however, a native woman was attacked by plague five days before full term; she was confined the same day and died, but the child was born alive; it exhibited no symptoms of plague, and is still living.

The skin was hot and burning to the touch from the first, and continued dry and harsh until the temperature began to decline on the third or fourth day, after which it became moist. On the temperature falling to normal or subnormal sweating almost invariably occurred and continued for a few days, being usually worse at night.

Occasionally before death petechiæ were observed over buboes or on the abdomen; but no characteristic skin eruptions were seen. In some instances small patches of skin (unconnected with lymphatic glands) two or three inches or more in diameter became inflamed, and eventually sloughed, leaving indolent ulcers with steep overhanging edges. These patches were noticed in some cases at the sides of the abdomen, and over the loins, where they were in no way due to pressure or irritation; but more frequently they occurred on the extremities, being situated on the dorsum of the foot or hand, on the leg, the thigh or forearm. Sometimes extensive sloughing occurred, laying bare the muscles over considerable areas and giving rise to severe hæmorrhage. Rarely boils were seen which became black, owing apparently to capillary hæmorrhage; but no true carbuncles were observed.

Amongst natives the progress of the disease was towards death in about 70% of the cases admitted into the Arthur Road and Parel Hospitals; among Europeans and Eurasians treated in St. George's Hospital the mortality was less, *viz.*, 32·35% and 42·62% respectively. As death approached, respiration became more and more shallow and feeble, the eyes became sunken, and the patient passed from a state of muttering delirium into coma, and died, as a rule, quite quietly from heart failure.

Sometimes the temperature ran up to 107° F. or more before death, and continued to rise after death; but more frequently death appeared to occur from collapse, the temperature falling and the pulse increasing in frequency to such an extent that it could not be counted. In cases that recovered the temperature generally fell by lysis on the fifth, sixth and seventh days. But not infrequently a fall by crisis occurred on one of these days (*vide* Charts II, VIII, XXII), and the patient remained in a more or less collapsed condition with subnormal temperature, profuse perspiration and an exceedingly feeble pulse for days. In this condition the slightest effort sometimes gave rise to fatal syncope. In the Parel Hospital 22 convalescents, out of 304 cases treated there by Surgeon-Captain Thompson, dropped dead through attempting to get out of bed or to sit up.

When the patient was recovering, it was occasionally found that he was suffering from dumbness or from partial laryngeal paralysis; or that hemiplegia, paraplegia involving the legs or the legs and arms, monoplegia of a limb or a portion of a limb was present. In some cases facial paralysis was observed, or paralysis of one or more ocular muscles. More rarely the in-co-ordination of the tongue, hands, arms or legs, noticed at the beginning of the attack, remained present during convalescence, and the speech continued slow, thick, and indistinct (*vide* the case of Kallian Vishram given below).

Occasionally an attack of plague ran a very mild course, the patient (frequently a boy of 10 or 12 years) not being confined to bed by it. In these cases enlargement and tenderness of a lymphatic gland was noticed, followed by fever (*vide* Chart XXVI), headache, a characteristic tongue, and sometimes nausea and vomiting; the temperature rarely exceeded 103° F. or 104° F., and generally fell to normal or subnormal on the second or third day. Prostration and cerebral symptoms were not well marked, and the bubo subsided, as a rule, without suppurating. The duration of the attack seldom exceeded three or four days, and convalescence was established in a week or ten days.

There remain to be described two forms of the disease in which the general features of plague in its most acute form were present, but in which there was no particular enlargement of lymphatic glands (buboes) during life, and in which, after death, only very slight general enlargement and congestion of the glands were found.

In one of these forms of plague the microbe grows in the blood, hence it has been called *septicæmic plague*; in the other it grows in the lungs giving rise to *primary plague pneumonia.*

In *septicæmic plague* the invasion was usually marked by a prolonged and severe rigor, or repeated rigors, and vomiting, headache and high fever were constantly present. The most distinctive features of this form of the disease were the great nervous prostration and muscular weakness present from the beginning, and the rapidity with which cerebral symptoms supervened. Delirium often set in during the first day, and was quickly followed by picking at the bed clothes, stupor and coma, in which the patient died generally on the second or third day, but sometimes within 24 hours of the onset. In some cases death did not occur for several days. The pulse early became soft and very frequent, 120 to 140 or more, the temperature (*vide* Chart XXV) rapidly rose to 104° F., 105° F., 106° F., ran an irregular course and often reached 107° F. or more before death; respiration was hurried and panting, gastro-intestinal catarrh and tympanitis were frequently present, the urine was often retained. Epistaxis and sub-conjunctival hæmorrhage sometimes occurred; blood was occasionally seen in the stools and urine; and if the patient lived long enough, secondary pneumonia sometimes set in. These cases were very fatal.

In a considerable number of cases *primary plague pneumonia* was observed, the development of the disease being due to the growth of plague bacilli in the lung tissue. Lobular pneumonia was the form usually met with in these cases. Its onset was marked by rigors, or, in some instances, by chills, followed by a sense of constriction across the chest, difficult and hurried breathing, cough and expectoration. As the disease progressed, respiration became very frequent (40 to 60 in the minute) and difficult, and duskiness of the face appeared. Pain was present, but never appeared to be severe or stitch-like in character, and was rarely much complained of. The expectoration, bronchitic at the beginning, very soon became watery and profuse; it often contained little whitish specks floating in it and on examination was found to contain plague bacilli in great numbers. Frequently this serous expectoration was tinged of a pink or reddish colour from the presence of blood; but rusty sputa, as in ordinary croupous pneumonia, were rarely seen. There was great prostration from the first; the pulse soon became feeble and very frequent, so that the alteration in the pulse-respiration ratio ordinarily met with in pneumonia was not observed; the temperature was high and ran an irregular course; (*vide* Charts XI, XII, XVII, XIX, XXIX, XXX, XXXI,); the tongue was coated white, except at the tip and edges, and the bowels were confined. The physical signs present were those of broncho-pneumonia, patches of consolidation being found in one or both lungs, the right generally being the one most affected. Very soon marked œdema occurred, the lungs becoming loaded with fluid. Buboes were not met with in these cases, but slight enlargement of the lymphatic glands was sometimes found before death. Death generally ensued in three or four days, and was preceded by incessant cough and by blueness of the skin due to deficient æration of blood, caused mainly by the amount of fluid in the air vesicles.

The complications met with in plague were—in the nervous system delusions, in one case ending in insanity; motor paralysis, local or general; impaired sense of touch; sometimes diminished sensibility to pain, sometimes hyperæsthesia; deafness; ulceration of the cornea, conjunctivitis, and sub-conjunctival hæmorrhage. In the circulatory system, softening of the muscular tissue of the heart with enfeebled cardiac action and dilation of the heart. In the respiratory system, bronchitis; hypostatic congestion and œdema of the lungs, secondary pneumonia; pleurisy; and rarely pulmonary hæmorrhage. In the digestive system, gastro-enteric catarrh; diarhœa; and in a few cases hæmorrhage from the bowels. In the urinary system, albuminuria; renal congestion, and renal hæmorrhage, in one case causing death. In the reproductive system, menorrhagia at the menstrual period; and abortion in many cases of pregnancy. In the cutaneous system, sloughing of the skin, and boils.

The sequelæ most frequently met with were deafness in one or both ears; impairment of vision due to degeneration of the choroid and retina; dumbness due to the loss of memory of words, or to laryngeal paralysis; paralysis of the muscles of the eyes or face; paresis or paralysis of the muscles of the extremities either hemiplegic or paraplegic; in-co-ordination of the muscles of the face, tongue and extremities (*vide* case given below); impairment of cutaneous sensibility to pain.

The duration of the disease in 902 fatal cases admitted into hospital, was 19 hours in one case, one day in 5, two in 43, three in 99, four in 143, five in 129, six in 85, seven i 76, eight in 56, nine in 42, and ten in 24 cases. It must b remembered that probably very few of the cases dying during the first 24 hours were brought to hospital, and that many of the cases dying on the second and third day were also not detected and sent to hospital. The average duration of the disease from attack to death in 17 fatal cases among native prisoners in the House of Correction, Byculla, was 5½ days.

Second attacks from plague occurred in two cases which have been recorded. In the first case the patient who had suffered from plague at Hongkong in June 1894 was attacked in Bombay on the 6th December 1896, had rigors, vomiting, high fever, (105° F.), severe headache and a bubo in the right groin. The fever and other symptoms subsided within a week and she recovered. The second case was that of a cooly admitted into the Arthur Road Hospital in November 1896 for plague. He was discharged cured in December and continued to work until February 1897, when he was re-admitted for plague and died.

The diagnosis of plague in its most typical form is easy. The sudden onset, rapid rise in temperature, vomiting, headache, sleeplessness, the stupid expression, injection of the eyes, thick speech and great prostration point to plague; and later, the condition of the tongue, the frequent and very feeble pulse, the enlarged and painful lymphatic glands, the course of the temperature (showing a marked fall on the second or third day followed by a further fall to normal or subnormal between the fifth and seventh days) and the rapidly fatal course of the disease in the majority of cases, render the diagnosis unmistakeable.

When, however, the disease takes the form of *primary plague pneumonia*, it becomes exceedingly difficult to diagnose, whilst at the same time, owing to the danger of infection from the sputa which contain plague bacilli in great numbers, it is most important to recognise it early. In primary plague pneumonia the absence of acute or subacute bronchitis before the attack, the rapidity with which high fever, severe headache and marked prostration occur after the onset, the character of the expectoration, less viscid from the first and early becoming profuse and watery, and generally tinged with blood or reddish from admixture of blood, the rapidity with which signs of œdema of the lungs appear; the quality of the pulse, which is never full and bounding, and soon becomes very soft and frequent, serve to distinguish it from ordinary broncho-pneumonia or lobar pneumonia in the majority of cases, and the presence in all cases of immense numbers of plague bacilli in the sputa, from which cultures can be obtained, renders the diagnosis certain.

Severe cases of *malarial fever* may be distinguished from plague by the nature of the onset, the cold stage being more prolonged, the features pale and shrunken, and the nails blue. In the hot stage the face becomes flushed and the pulse full and bounding, but is not so frequent as in plague. In malarial cases, too, the temperature generally shews marked periodicity, there is no prostration, patients possessing as a rule their muscular strength and mental energy, and buboes are very rarely met with.

Relapsing fever, like plague, occurs in times of scarcity. In both the onset is sudden, and rapidly followed by high fever, accompanied by severe headache, frequent pulse, and a hot and burning skin, the tongue is furred white, the temperature reaches its maximum on the first or second day, and a remission accompanied by sweating often occurs on the second or third day, the temperature falling to normal between the fifth and seventh day (*vide* Chart XXI). But in relapsing fever there is giddiness, prostration is slight, jaundice not infrequently occurs on the third or fourth day, the face is flushed, and the expression is not stupid nor confused, buboes are not met with, and spirilla are found in the blood during the height of the fever.

Plague in its onset and early symptoms somewhat resembles *Typhus fever*. But the duskiness and flushing of the face present at the beginning of typhus fever and the occurrence of an eruption on the body and limbs between the fifth and seventh days, as well as the different course of the temperature (*vide* Chart IX.) and the absence of buboes would serve to distinguish between them.

Owing to the feebleness, thick utterance and staggering gait, frequently seen in plague cases, the disease is sometimes mistaken for *alcoholic poisoning*. The following is a typical case. Govind Jeeva was taken by his friends for treatment to a qualified medical practitioner. They stated that he had had a fall, and the following note of his case was made: "Pupils slightly dilated, breath smells very faintly of alcohol, has a slight contused wound over but not exposing malar bone," and an emetic was prescribed. Fortunately this was not given. Next day a note was made as follows: "Bowels not opened for two days, is not quite recovered from the effects of drink," and on the following day: "Speech indistinct, temperature 102° F., bowels not opened." On the fourth day he died. In this case enquiry showed that the patient had been two days ill with fever, and was given a little alcohol after having fallen down in a faint. He was seen by another medical man shortly after the emetic was prescribed, and found to have a very frequent and feeble pulse, fever, and a typically coated tongue. The diagnosis of plague was made and afterwards verified by *post-mortem* examination. Had the case been one of alcoholic poisoning, there would have been a full and bounding pulse, a normal or subnormal temperature, and considerable mental excitement, or in a later stage, drowsiness or coma with stertorous breathing, a slow and compressible pulse, and a subnormal temperature.

In plague cases where *abdominal symptoms* are marked and a typhoid condition has supervened, the diagnostic features given by Surgeon-Captain Hojel are:—The onset is sudden, usually ushered in by a well marked rigor, the temperature shows a high initial rise in most cases, followed by a marked remission to normal (or a little above or below it) on the second, third or fourth day (*vide* Chart XXIV); the pulse large and full at first, becomes peculiarly soft and is characterized by a great want of sharpness in stroke, it is very compressible at an early stage and dicrotic, but the dicrotism is not very easily recognised by the finger, the aspect is dull, heavy and apathetic, and the patient has a peculiar stricken look, the eyes are dull and muddy-looking, the conjunctivæ are suffused, but the pupils in most cases are normal, there is generally flushing of the face; diarrhœa when present is simple, but very offensive; delirium and other cerebral disturbance occurs early, and there is great prostration from the first; abdominal distension occurs early, on the third, fourth or fifth day, the eruption is not readily effaced and is of a "deep red colour (petechial)"; there is severe pain lumbar in many cases.

During the present epidemic no cases of *glandular fever* among children or young adults were met with, nor did an outbreak characterized by the appearance of buboes, and accompanied by a little or no constitutional disturbance, precede or accompany the outbreak of plague in Bombay. Until bacteriological diagnosis has settled that the microbe in these cases is the plague bacillus, it is premature to speak of them as cases of benign plague. In Calcutta a number of cases of this sort occurred over twelve months ago, but up to the present no outbreak of plague has followed.

The bacteriological diagnosis of plague has been purposely omitted, as it will be given in full detail in M. Haffkine's report. Besides, it cannot be carried out in practice by medical men who have no special bacteriological training nor access to a laboratory, and as they are the first persons who come in contact with the disease, it is of especial importance that they should be able to recognise plague cases by their ordinary clinical features.

The *prognosis* of plague is always exceedingly grave, as it is the most fatal of all known epidemic diseases. Dr. Viegas who practises on the Port Trust Estate and was the first to notice the presence of plague in Bombay about the third week in September 1896, states that the mortality during the first four weeks after the outbreak was discovered, lay between 95 and 99%, and between the end of October and the end of November between 85 and 90%.

The mortality in 1,579 cases treated in the Arthur Road and Parel Hospitals was 69·54%. In the Poona Plague Hospital out of 1,130 patients admitted, 757 died, giving a mortality of 67%.

In the House of Correction, Byculla, however, where the entire number of those attacked were admitted into hospital at once, only 17 persons died out of 33 attacked, or 51·52%. These prisoners were all adults between 20 and 50 years of age, in good bodily health, and carefully attended to from the time they fell ill.

In Damaun, out of 110 persons living in the same families, 54 were attacked by plague, of whom 37 or 68·52% died.

Under ordinary conditions therefore the mortality among those attacked during the present outbreak was probably between 65 and 70%.

Looking at the mortality, according to race and caste, among the patients admitted into Arthur Road and Parel Hospitals (Table II), the highest mortality, 71·25% occurred amongst Hindoos, then follow Jews with 66·67%, Native Christians with 65·45%, Brahmins with 65·21%, Parsees with 64·29%, and Mahomedans with 64·24%: the number of Jews (9), Brahmins (23) and Parsees (14), however, were too small to give reliable results.

Among Europeans and Eurasians a much lower death-rate, 38·95%, occurred, owing most probably to their possessing more stamina, and being treated earlier and more carefully nursed during the attack. Out of 34 Europeans admitted into St. George's Hospital, 23 recovered and 11 died, the percentage of deaths to attacks being 32·35°/o, while out of 61 Eurasians under treatment, 58 recovered and 37 died, or 42·62°/o of deaths to attacks. Table I shows the recoveries and deaths among Europeans and Eurasians at the different periods of life, but the numbers are too small to attach much value to their analysis. It will be noticed, however (Table III) that while among natives the lowest percentage of deaths to attacks occurred between the ages of 1 and 20 years, in Europeans and Eurasians it lay between the ages of 20 and 40 years; also that between 20 and 40 years the percentage of deaths to attacks was twice as high among natives (69·75%) as among Europeans and Eurasians (34·21%).

It is impossible to give any definite prognosis with regard to individual plague cases, as sometimes those that appear to be quite hopeless recover, while others apparently much less severe die. The conditions regarded as most unfavourable are the occurrence of the disease in its septicæmic form, or as primary plague-pneumonia. Among cases in which buboes are found, those where the buboes are situated in the cervical region appear to be more unfavourable than those with buboes in the axilla or groin, and cases with multiple buboes are more unfavourable than those with single buboes. The symptoms which are generally looked upon as unfavourable are the persistence of severe and continuous vomiting, and the early appearance of diarrhœa, the early onset and continuance of violent delirium, or the setting in of coma. The appearance of petechiæ is generally believed to precede death, and hæmorrhages from the kidneys and bowels are considered very unfavourable.

Attacks occurring late in the epidemic, although often no less severe in their onset, (Chart XXVI) run a milder course than those occurring at the beginning of the outbreak.

Treatment.—No specific remedy has up to the present been discovered for the treatment of plague cases.

During the present epidemic two lines of treatment have been tried, the one, ***hygienic and symptomatic***, with the object of tiding the patient over a certain period when, as in the case of the other specific fevers, experience has shown that there is a natural tendency to recovery, the other, ***the antitoxic treatment***, with the object of neutralizing by means of antitoxic serum the virus produced by the microbe, and of preventing the growth of the bacillus itself.

The hygienic and symptomatic treatment consists in economising, as far as possible, the nervous and muscular energy of the patient by placing him under the most favourable conditions and treating symptoms. With this object a plague patient is put to bed at the onset of the disease, kept in the recumbent posture (on account of the tendency which there is to fatal syncope) until convalescence is established, and supplied with suitable nourishment at short intervals.

The symptoms which require special attention are those connected with the nervous system and with the circulation. In the nervous system they are mainly due to congestion of the nervous centres at the commencement of the attack, followed by œdema towards its close, the former giving rise to fever, headache, vomiting, insomnia and delirium, the latter to stupor and coma. These symptoms are treated on general lines, *i. e.*, the avoidance of light, the application of ice or cold water to the head and surface of the body if the temperature continues high, and the use of hypnotics and sedatives for sleeplessness and delirium.

In connection with the circulation the symptoms to be combatted are vasomotor paralysis and heart failure, the latter probably due partly to the direct action of the toxic poison on the cardiac ganglia and partly to softening and degeneration of the muscular wall of the heart. For these symptoms the use of alcohol in some form is generally required after the first day, in most cases also the administration of drugs which act as cardiac tonics and vascular stimulants, such as ammonia, digitalis, strychnine, quinine, is found necessary. All drugs which depress the heart and circulation should, as far as possible, be avoided.

The treatment of pneumonia, primary or secondary, calls for the free administration of stimulants and of stimulating expectorants for the relief of cough and dyspnœa due to the accumulation of fluid in the bronchial tubes.

Gastro-intestinal symptoms, buboes and such other complications as arise are managed on general principles.

In *treatment by antitoxine* the correct principle of removing the cause of the disease is aimed at, but up to the present time, so far as information is obtainable of M. Yersin's results, and those of other doctors, French and Russian, who have tried it, it has failed to influence favourably the mortality among those attacked.

Surgn.-Captain Thomson the Medical Officer in charge of Parel Plague Hospital, has kindly supplied me with a tabular statement (*vide* Table VIII) showing the details of 27 cases under his care treated by M. Yersin's antitoxic serum. From these 27 cases he excludes 4 (2 of which died and 2 recovered), *viz.*, one suffering from meningitis and an osseous tumour pressing on the medulla (case 4), one treated prophylactically (case 11), and two which were not plague cases (cases 24 and 27). Of the remaining 23 plague cases, 14 or 60·83 per cent. died.

The detail of the cases treated by M. Haffkine with the antitoxic serum prepared by him in Bombay will be found in his report.

The *prophylactic measures* which demand attention on the occurrence of a case of plague in a family are the removal, when practicable, of the unaffected members from the house, to allow of its being thoroughly cleaned, and of the patient to a hospital, where he can receive proper care and attention, unless suitable provision can be made for his treatment at home. All those who have been living with him should undergo inoculation against plague, as this is found to diminish the risk of infection by 70 to 80 per cent., and to increase the prospect of recovery in those attacked after inoculation by 60 to 70 per cent. (*vide* report on inoculation). The patient's sputa and excreta and all discharges from buboes and sores should be received in vessels containing suitable disinfectants, and on the termination of the illness everything which was used by him, or had been rendered liable to contamination, should be thoroughly cleansed and disinfected, or, if practicable, burnt (*vide* Mr. Hankin's report).[*]

Nurses and attendants who are in close and constant attendance on plague patients should undergo inoculation. All wounds and abrasions on the hands, etc., should be protected from the risk of infection, and the hands should be thoroughly washed and disinfected after dressing sores or otherwise becoming soiled. Their natural immunity should be increased as much as possible by regular meals, sufficient exercise and rest to ensure their keeping in good health.

CASES ILLUSTRATING THE COURSE OF PLAGUE IN THE INOCULATED.

Kondabai, a female, aged 11 years, came from a compound in which four other servants were attacked by plague, three of whom had died. Kondabai and the other servant who recovered were inoculated with M. Haffkine's prophylactic lymph nine days before she was attacked.

When first seen on the 21st February 1897, at the Arthur Road Hospital, she was delirious, her expression was frightened, the eyes were not red nor injected. The pulse was frequent, 126 per minute and rather wiry, respiration 35 per minute, temperature 103° F. Her tongue was moist and somewhat swollen and thickly coated white except at the tip and edges; the bowels were confined. Her father stated that she had had slight fever after inoculation, and that previous to the onset of plague symptoms she had been in good health. She was attacked on the previous night by shivering, vomiting and headache, and at the same time a very painful bubo appeared in the cervical region at the angle of the lower jaw on the right side. There was a good deal of infiltration into the cellular tissue around the gland, giving rise to a painful swelling which prevented her opening her mouth freely. She had slight cough with tough and scanty expectoration. On examining the lungs the bases were slightly congested, particularly the right. The heart sounds were normal. The liver and spleen did not appear to be enlarged, but it was very difficult to examine her, as she was delirious and could hardly be kept in bed. Vomiting had ceased. The urine was passed involuntarily, and was not examined. There was no skin eruption. On the evening of the 21st her temperature had run up to 106° F., (*vide* Chart VIII)[†] pulse was frequent and fair in volume, there was a doughy swelling filling up the interval between the lower jaw and the neck and extending for a short distance downwards; the corresponding cervical gland on the left side was also inflamed and tender. She was very delirious, the cough continued, but no examination of her lungs was possible. On the morning of the 22nd she was still delirious, but became conscious towards the evening, her temperature falling to 102·4° F. Next morning a painful gland appeared in the right axilla. All these glands eventually suppurated; otherwise the course of the disease presented no features of special interest.

Noronha, a clerk in the office of the B. B. and C. I. Railway, left his house in Girgaum and went to live in the Fort on the 1st April 1897. He had been inoculated with M. Haffkine's prophylactic against plague on the first, and on the 3rd March, having been given 3 c. c. on the first and 3½ c. c. on the second occasion. He was attacked by plague on the 9th April. The disease set in with a chill, followed by fever, severe headache and acute pain in the left groin. He stated that on the 1st April a mouse was found dead under his cot, and on the 2nd April a dead rat was discovered in the house. On the 12th April the fever and headache diminished considerably. On the 13th February he was seen by Dr. Bhalchandra Krishna, who found he had a temperature of 100° F. and a left femoral bubo, and diagnosed the disease plague. On the 14th he had no fever and afterwards attended Dr. Bhalchandra's dispensary for medicine, and made an uninterrupted recovery.

A CASE OF MARKED GENERAL IN-CO-ORDINATION AND PARESIS AFTER PLAGUE.

Kallian Vishram, aged 19, a Hindu, by occupation a clerk, was admitted into the Jamsetji Jijibhoy Hospital on the 27th September 1897 for inability to walk.

Towards the middle of April 1897 he was attacked with plague at Musjid Bunder (Mandvi) and removed to the Jain Hospital. His wife had died from plague. On the day after admission he became unconscious, and on recovering consciousness was unable to feed himself, and his legs were feeble and unmanageable as at present. He was discharged from the Jain Hospital towards the end of May; the bubo, which was in the right groin, having cicatrized. He never had syphilis, but had a mild attack of small-pox four years ago.

He was brought on a stretcher to the ward; nutrition is good; the facial expression is vacant and stolid, all the muscles are quite toneless; he lies on his back and finds great difficulty in turning from side to side or sitting up; he is unable to perform any movements with steadiness and precision. When sitting up, movements of the arms and legs are made with sudden jerkiness and with wider range than normal. The pulse is regular, 52 per minute, of fair volume and tension; respiration 20 per minute, jerky and irregular in rhythm.

The muscles are fairly nourished, but relaxed. Electrical reactions are normal; the feet are rather flat; and the hands are held as seen in drop-wrist. Superficial reflexes are present; the planter reflex elicits a sudden and forcible movement. There is marked in-co-ordination of the muscles in general. The head falls forwards and is moved from side to side, instead of being turned to look at objects. On attempting to get out of bed the legs are extended with suddenness, and then thrown outwards with a forcible jerk; he sits holding on to the edge of the bed to maintain his balance; stands with the feet widely apart and leans forwards so as to see their position. The muscles are tremulous, and movements markedly exaggerated, the legs crossing one another, when a step is taken, and thrown forward with a sudden jerk, the toes being brought to the ground forcibly, and the body swaying like that of a drunken man. The movements of the hand are exaggerated and unsteady, the right being worse than the left. When the hands are at rest, the fingers tremble irregularly. Simple movements of the hand are accomplished by spasmodic jerks, and fine movements are most clumsily attempted and imperfectly finished, as is seen on carrying a spoon to the mouth or tying a string. He is unable to maintain his balance in any position.

The acts of swallowing, defæcation and urination are properly performed but delayed.

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[*] Not published with the Proceedings of the Commission.

[†] Chart XVI shows the course of the temperature, pulse and respiration in an attack of plague occuring three days after inoculation with Mr. Haffkine's prophylactic.

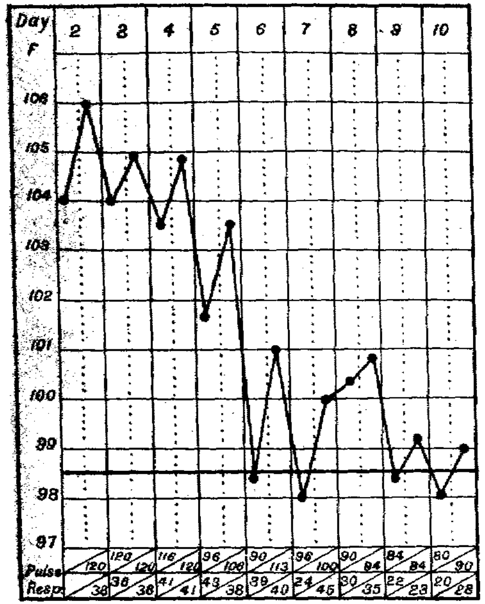
There are no lightning pains, nor formication of the extremities. He does not complain of giddiness, or of gastric or rectal crisis. He has not suffered from vomiting or girdle sensation. Sensibility to touch is delayed but not actually diminished, and the patient is unable to recognise how often he has been touched or by how many fingers. His sense of feeling amounts to something being brought in contact with his body, but he is unable to recognise what it actually is. Sensibility to pain is somewhat diminished, a forcible pinch giving him pain after a little time. Sensation to heat or cold is not affected. A hot tube passed along the course of the spine gives a burning sensation at the 1st, 2nd, 3rd and 4th dorsal vertebræ. No spinal nor cranial percussion tenderness is present. Cerebral, mental, vaso-motor and nutritive functions are not in any way altered. There have been no trophic changes.

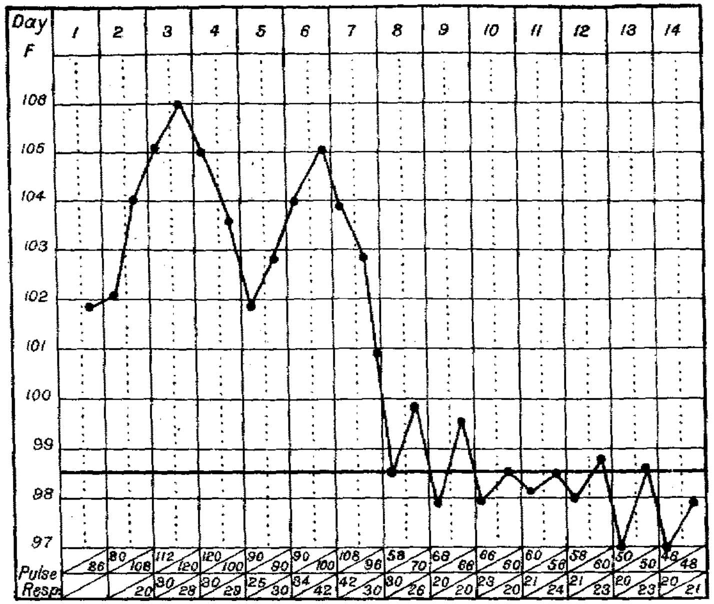
Articulation is slow and deliberate; individual syllables are pronounced separately and forcibly, laying great stress on the final part of the word. The answer to any question put to him takes time, and the act is deliberate. He is intelligent and understands all that is said to him.

Taste is normal; hearing is somewhat diminished in the right ear, but he does appreciate after a time the character of the sound: smell normal.

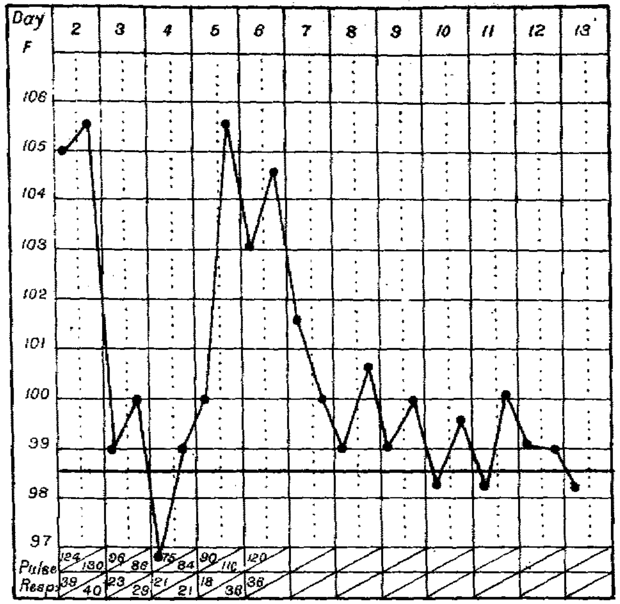
There is no nystagmus. The left eyeball does not move outwards to the same degree as the right; besides this deviation in the axis, there is nothing peculiar. Pupils are moderately dilated and the Argyll Robertson phenomenon is not present; pupils react to light and accommodation. In both eyes there is a well defined area of old choroiditis between the optic disc and yellow spot. This is quite symmetrical in both eyes.

All other systems were examined and found normal. The patient has been under observation for some time and has as yet shown no improvement. The symptoms present exactly resemble those seen in many severe cases of plague after the second day.


L. (E.) L. Femoral Bubo. Suppurated Rec.


II

J. G. G. (E.) L. Fem. Bubo. Suppurated Rec.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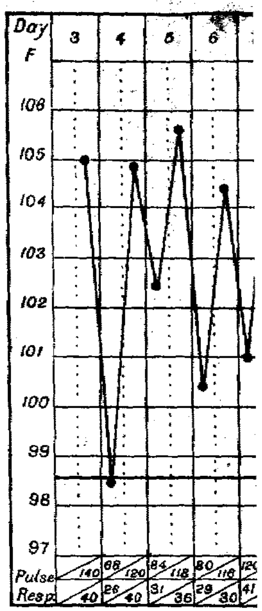
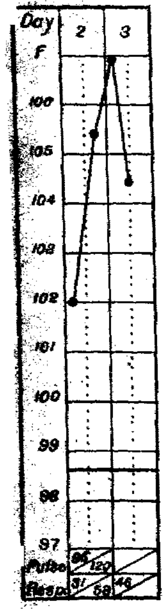
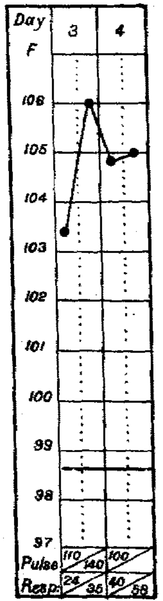
P. S. (H.) L. Fem. Bubo. Suppurated Rec.


IV

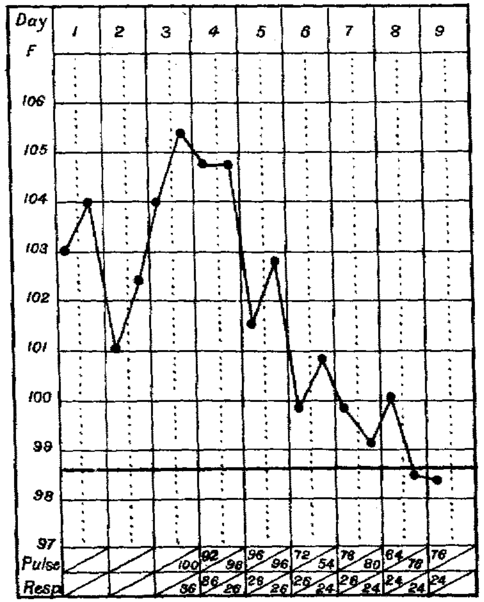
L. A. (H.) L. Fem. Bubo.


V

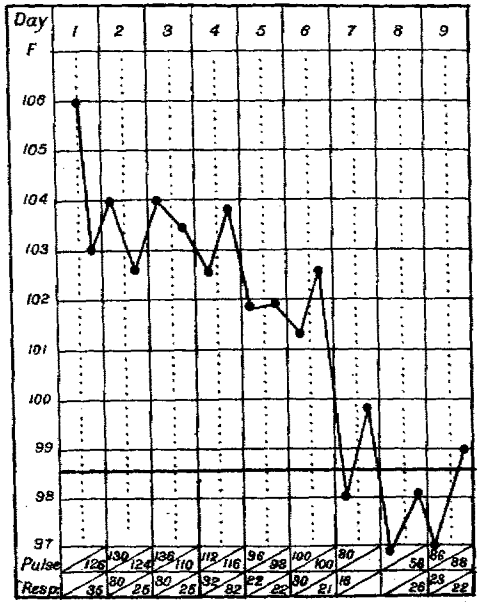
B. R. (H.) D.


VI

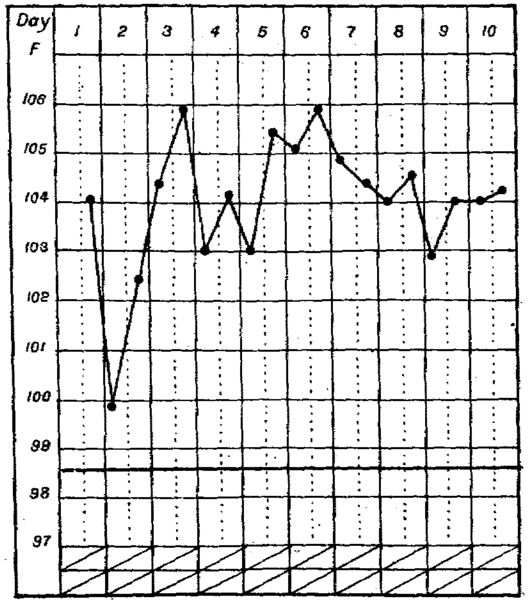
R.


VII

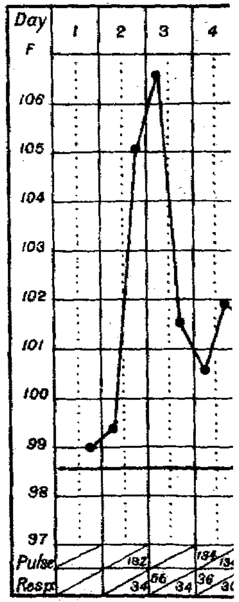
W. (E.) L. Fem. Bubo. Resolution Rec.


VIII

K. (H.) Rt. Parot Rt. Axil Lt. Parot Suppurated
9 days aft. Haffkine's Prophylactic S. Rec.


IX

Typhus Chart from Wunderlich.


X

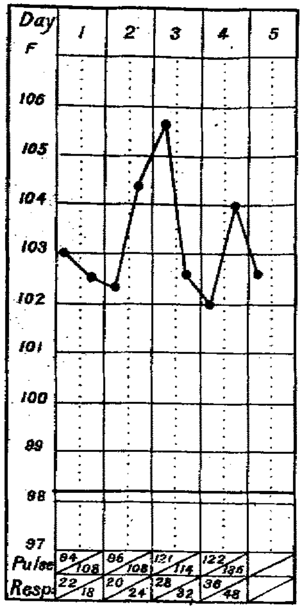
B. B. (H.) Rt. Submax

(E.) = European. (N. Ch.) = Native Christian. (H.) = Hindu. L. = Left. Rt. = Right. Rec. = Recovered. D. = Died. Letters at left corner = Patients initials.

Appendix XIV.

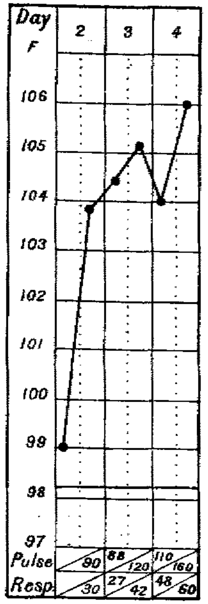
XI

R. M. (E.) Bron. Pneumonia No Bubo. D



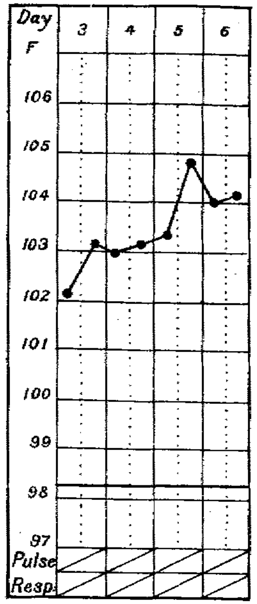
XII

E. J. (E.) Br. Pneumonia No Bubo. D



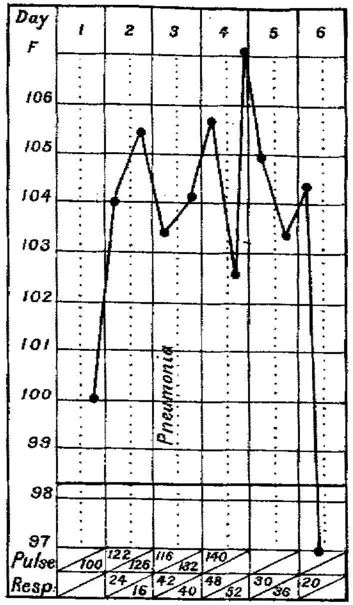
XIII

K. B. (H.) Br. Pneumonia No Bubo. D



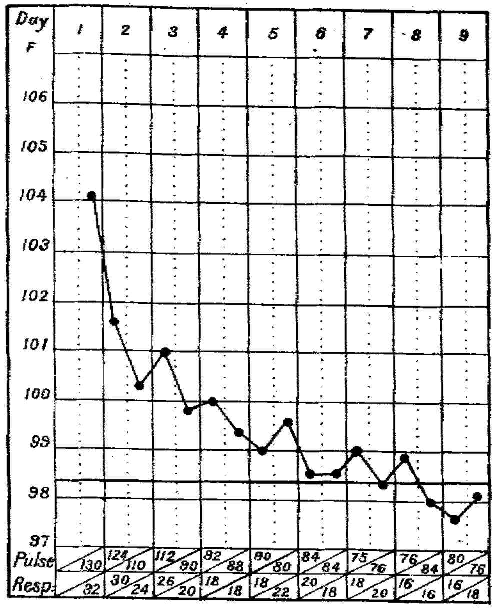
XIV

R. G. (H.) R. Axil. (Second. Pneumonia) D



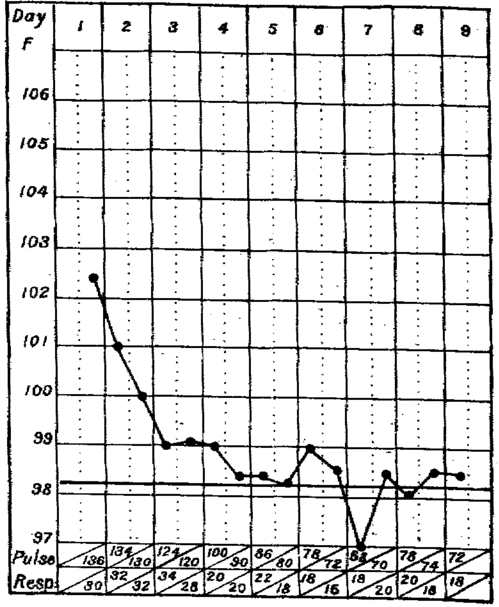
XV

K. L. (H.) Rt. Lt. Fem. Bubo. Diarrhœa



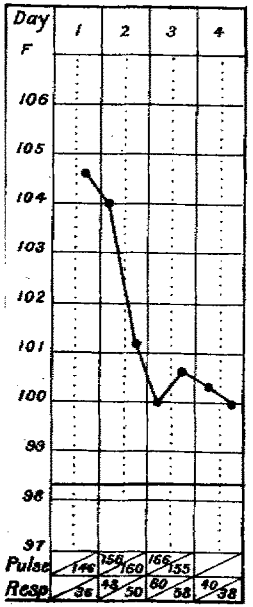
XVI

G. B. (H.) Rt. Axil. Bubo. R.
8 days aft. Haffkine's Proph. Serum.



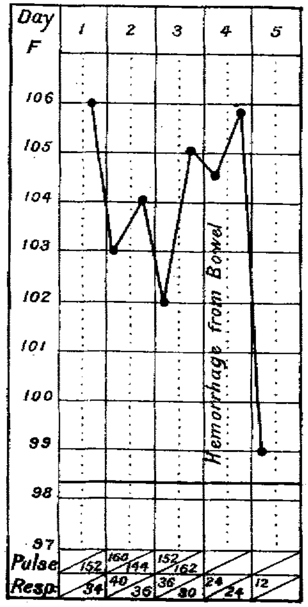
XVII

B. M (H.) Br. Pneumonia No Bubo. D



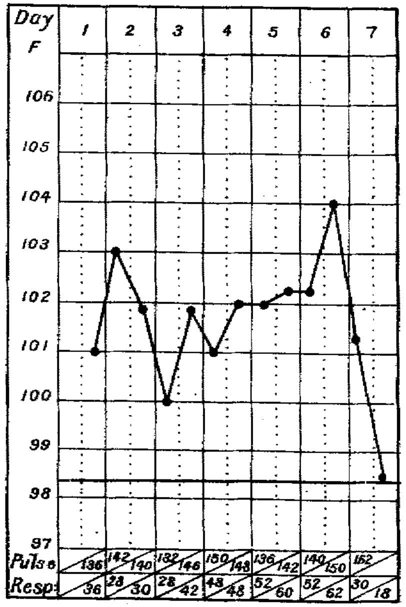
XVIII

W. Ch. (M.) Rt. Fem. Bubo. D
Hemorrhage fr. Bowel.



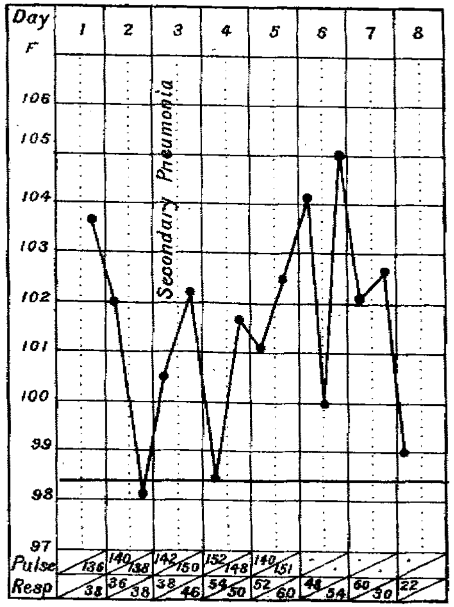
XIX

V. J. (H.) Br. Pneumonia. No Bubo. D



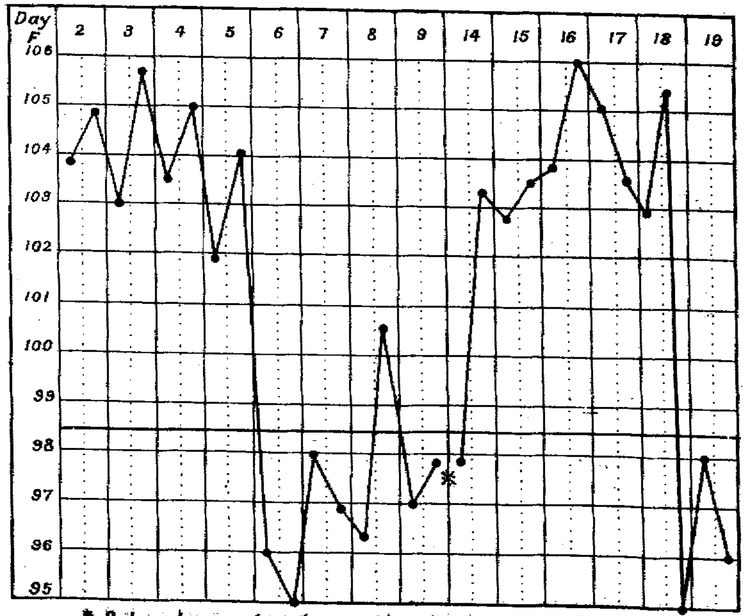
XX

A. K. H. (M.) Lt. Axillary Bubo D
Secondary Pneumonia



XXI

Relapsing Fever from J. J. Hospital.



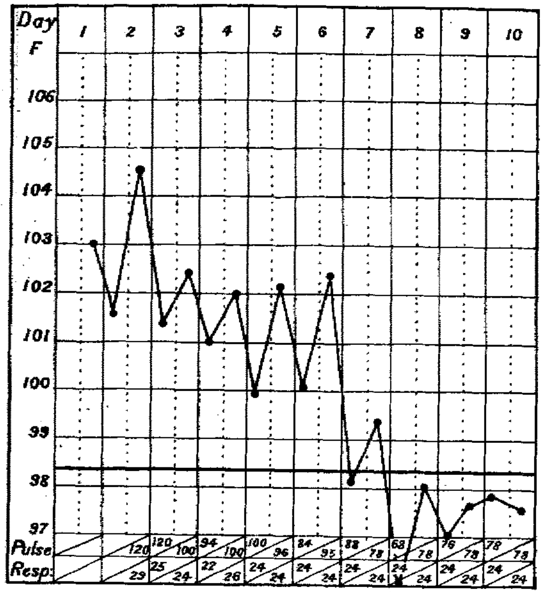
* 3 days temperature (normal) omitted.

Reg No 69 Secy.. India Plague Commission.—Mar. 99 —2,500.

Litho., S. I. O., Calcutta.

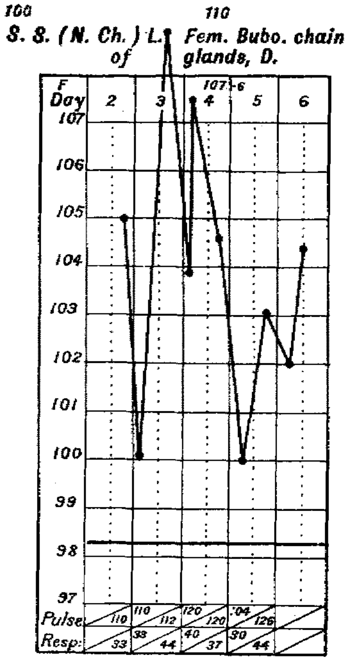
XXII

M. C. (E.) L. Fem. Bubo. Pregnant 2 months Rec.



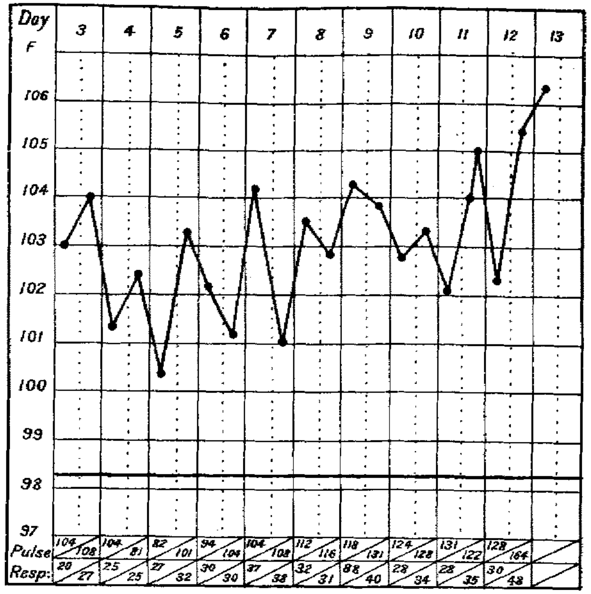
XXIII

S. S. (N. Ch.) L. Fem. Bubo. chain of glands, D.



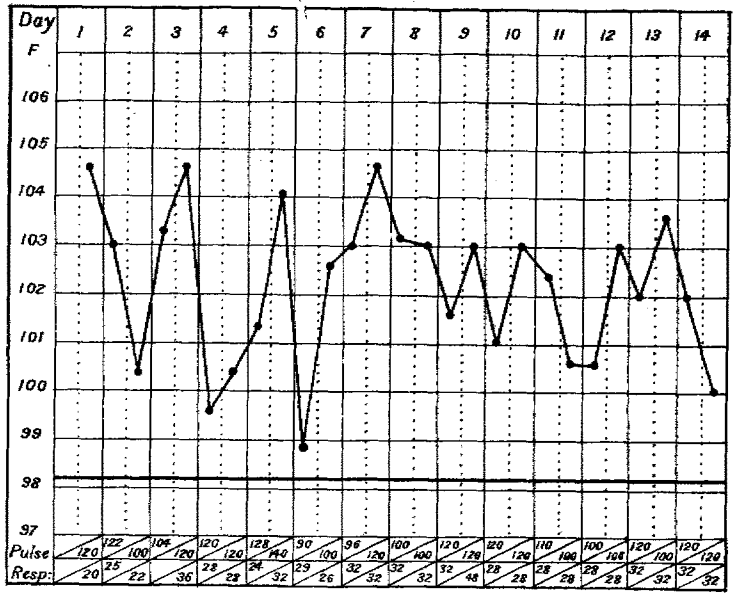
XXIV

J. S. (E.) No Bubo. Enteric symptoms, D.



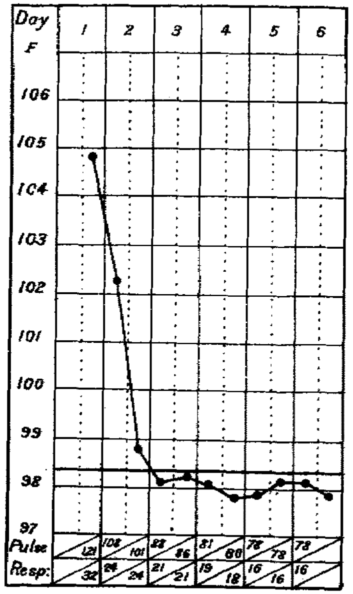
XXV

S. S. (Negro) Septicamic. D.



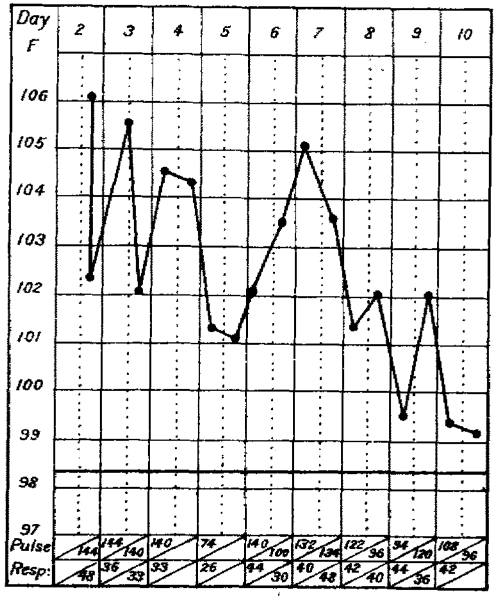
XXVI

H. T. (E.) R. Fem. Bubo. Rec.



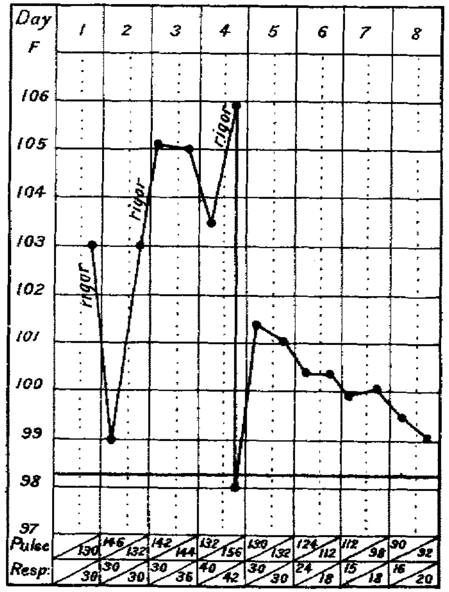
XXVII

P. N. (M.) Rec.



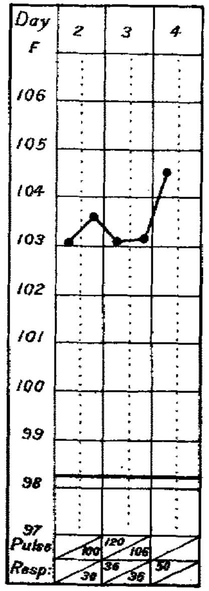
XXVIII

R. R. (H.) R. & L. Fem. Bubo. D. Rec.



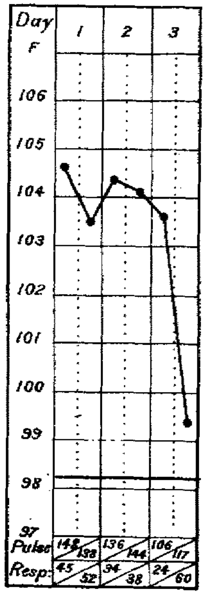
XXIX

R. B. (H.) Pneumonia D.



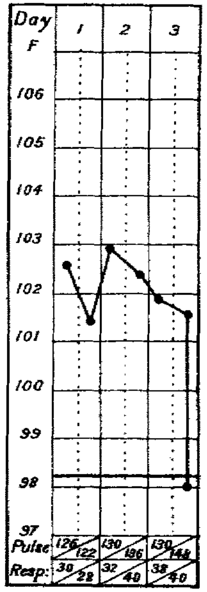
XXX

C. S. (H.) Pneumonia D.



XXXI

N. (H.) Pneumonia D.



XXXII

G. D. (H.) L. Fem. Bubo.

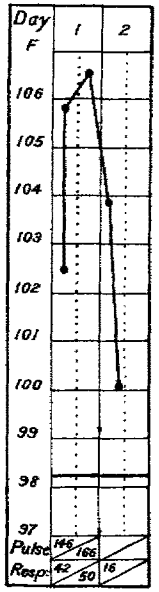


TABLE I.

A table showing the admissions among Europeans and Eurasians into St. George's Hospital, Bombay, at different periods of life, and giving the results.

		1 year and under.	Years 2 to 5.	Years 6 to 10.	Years 11 to 20.	Years 21 to 30.	Years 31 to 40.	Years 41 to 50.	Years 51 to 70.	Total.	Percentage of deaths to attacks.
Europeans	R	1	0	6	4	6	6	0	0	2	32·35
	D	0	1	3	0	3	2	1	1	11	
Eurasians	R	0	0	4	13	10	3	3	2	35	42·62
	D	0	0	2	12	6	2	2	2	26	
Total	R	1	0	10	17	16	9	3	2	58	
	D	0	1	5	12	9	4	3	3	37	
Percentage of deaths to admissions		0	100	33·3	41·38	36	30·76	50	60	38·95	

R = Recovered. D = Died.

TABLE II.

A table showing the admissions among Native Christians, Jews, Parsees, Muhammadans, Brahmins and other Hindus into the Arthur Road and Parel Hospitals, and giving the results: for the Arthur Road Hospital the admissions at the different ages are shown.

		1 year and under.	Years 2 to 5.	Years 6 to 10.	Years 11 to 20.	Years 21 to 30.	Years 31 to 40.	Years 41 to 50.	Years 51 to 70.	Total.	Treated in Parel Hospital.	Total.	Percentage of deaths to attacks.
Native Christians	R	0	1	4	19	14	7	9	0	54	22	76	65·45
	D	0	2	3	23	30	16	24	1	99	45	144	
Jews	R	0	0	1	0	0	0	1	0	2	1	3	66·67
	D	0	0	1	2	0	0	0	0	3	3	6	
Parsees	R	0	0	0	2	0	1	0	0	3	2	5	64·29
	D	0	0	0	1	1	1	2	0	5	4	9	
Muhammadans	R	0	0	0	16	19	9	7	0	51	8	59	64·24
	D	0	0	4	21	24	25	24	0	98	8	106	
Brahmins	R	0	0	0	2	2	1	0	0	5	3	8	65·21
	D	0	0	0	0	3	3	0	0	6	9	15	
Other Hindus	R	5	2	19	66	106	42	17	1	258	72	330	71·25
	D	0	6	32	139	246	150	112	6	691	127	818	
Total	R	5	3	24	105	141	60	34	1	373	108	481	69·54
	D	0	8	40	186	304	195	162	7	902	196	1,098	
Percentage of deaths to admissions		0	72·73	62·5	63·92	68·31	76·47	82·65	87·5	70·74	64·47	69·54	

TABLE III.

A table showing the comparative case mortality per cent. among (a) Europeans and Eurasians and (b) Natives, in youth, adult life and old age.

	Years 1 to 21.	Years 21 to 40.	Years 41 to 70.
Europeans and Eurasians	$\frac{28}{18}$ —or 391·137 per cent.	$\frac{25}{13}$ —or 34·21	$\frac{5}{6}$ —or 54·55
Natives	$\frac{177}{293}$ —or 62·34 „	$\frac{255}{588}$ —or 69·75	$\frac{49}{216}$ —or 81·51

TABLE IV.

*A statement showing the number of deaths from Plague in Bombay according to age and sex from August to December 1896.**

Months.		1 year and under.	Years 2 to 10.	Years 11 to 20.	Years 21 to 30.	Years 31 to 40.	Years 41 to 50.	Years 51 to 60.	Years 61 and over.	Total.
August	Males	...	...	...	...	...	...	...	...	...
	Females	...	...	...	...	...	...	...	...	...
September	Males	...	4	15	18	14	5	4	3	63
	Females	...	1	3	6	2	3	1	...	16
October	Males	1	11	58	81	36	23	10	4	224
	Females	...	15	23	23	10	12	5	1	89
November	Males	1	15	51	64	32	18	7	5	193
	Females	...	23	25	22	8	8	2	2	80
December	Males	1	56	208	291	183	91	42	18	890
	Females	2	49	109	95	50	45	14	17	381
Total	Males	3	86	332	454	265	137	63	30	1,370
	Females	2	78	160	146	70	68	22	20	566
Percentage		·26	8·47	25·41	30·99	17·30	10·59	4·39	2·58	...

* Details up to 31st May have not yet been received from the Health Department.

TABLE V.

Admissions into the Arthur Road Hospital according to Occupation.

Occupation.	Arthur Road.	Total.
Domestic Servants*	266	266
Mill-hands	147	147
Coolies	110	110
Syces	49	49
Beggars	41	41
Sepoys (including Native Soldiers and Police)	21	21
Dhobies, Labourers (each)	19	38
Dirzies	18	18
Gowlies, Metalworkers, Peons (each)	15	45
Cart-drivers	13	13
Malies	12	12
School children, Carpenters (each)	11	22
Barbers	10	10

Admission into the Arthur Road Hospital according to Occupation—contd.

Occupation.	Arthur Road.	Total.
Shopkeepers	9	9
Clerks and Butchers (each)	8	16
Printers	7	7
Masons	6	6
Shoe-makers, Painters, Sweepers (each)	5	15
Ward-boys and Lascars (each)	4	8
Priests, Sailors, Firemen, Wool-cleaners, Bakers, Carpenters, Compounders, Fishermen (each).	3	24
Unclassified	...	398
	...	1,275

* Including personal servants, cooks, hamals and masalchies.

TABLE VI.

*A statement showing the number of deaths from Plague in Bombay City according to Occupation from September to December 1896.**

No.	Occupation.†	Number of Deaths in				Total.
		September.	October.	November.	December.	
1	Municipal and Local Bodies (including Police)	...	...	2	19	21
2	Devotees, Bhikshuks, Fakirs, etc.	...	2	4	11	17
3	Indoor servants	2	3	5	26	36
4	Dhobies (washermen)	...	...	2	17	19
5	Servants not otherwise described	5	8	6	27	46
6	General Merchants	...	6	1	4	11
7	Bankers	...	1	2	9	12
8	Commercial Agents, Brokers, etc.	6	9	2	7	24
9	Commercial Clerks, etc.	1	11	8	36	56
10	Drivers of public vehicles	...	1	...	5	6
11	Cart-owners and drivers	...	3	4	15	22
12	Seamen (not Government)	...	...	...	5	5
13	Messengers, Porters, etc. (not Government)	...	3	1	6	10
14	Jockey Grooms	...	4	4	10	18
15	Fishermen, etc.	...	2	...	5	7
16	Printers by steam, compositors	...	...	...	8	8
17	Figure casters (Otarva)	...	...	...	5	5
18	Engine makers (fitters, etc.)	...	2	...	9	11
19	Carpenters, Joiners, Sawyers	...	3	4	18	25
20	Masons and Bricklayers	...	1	1	12	14
21	Cotton Dyers	...	...	...	5	5
22	Spinners, Weavers and Factory workers	...	1	...	16	17
23	Cotton goods sellers, drapers	1	1	...	3	5
24	Tailors	1	6	4	11	22
25	Shoe and Boot makers	...	1	5	14	20
26	Workers and sellers of Jute	...	5	1	...	6
27	Cow-keepers and milk-sellers	...	2	1	4	7
28	Grain, pulse and flour dealers	9	15	9	18	5[illegible]
29	Sweetmeat makers and sellers of pastry, cooks	...	1	1	10	12
30	Fruit and vegetable dealers	...	1	2	10	13
31	Grocers, spice-dealers	...	...	1	4	5
32	Stone-cutter	1	...	...	4	5
33	Gold and silver smiths	1	...	1	9	11
34	Black-smiths	...	...	1	5	16
35	General labourers and coolies	18	66	50	185	319
36	Factory labourers (unspecified)	...	7	14	92	113
37	Shopmen, etc. (unspecified)	...	9	3	19	31
38	Mendicants	...	...	2	20	22
39	Males following no occupation	2	6	4	32	44
40	Females do. do.	12	50	34	171	267
41	Children, males	16	41	49	188	294
42	Children, females	2	28	29	131	190
	TOTAL	77	299	257	1,205	1,838

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* The details up to 31st May 1897 have not yet been received from the Health Department.

† Occupations have been excluded in which less than 5 deaths occurred during the 4 months.

TABLE VII.

Statement showing the probable mortality from Plague in Bombay City from the commencement of the outbreak to the end of May 1897, and also showing the fall in the birth-rate.

For week ending	TOTAL DEATHS INCLUDING STILL-BORN.		Probable Plague mortality in 1896-97.	TOTAL BIRTHS EXCLUDING STILL-BORN.	
	1896 and 1897.	Mean of corresponding weeks in preceding 5 years.		1896 and 1897.	Mean of corresponding weeks in preceding 5 years.
August 4th	564	564	...	287	313
„ 11th	598	534	64	311	307
„ 18th	650	538	12	263	297
„ 25th	669	581	88	298	301
September 1st	667	540	127	345	291
„ 8th	593	531	62	346	312
„ 15th	618	492	126	321	273
„ 22nd	647	506	141	304	271
„ 29th	720	527	193	339	338
October 6th	791	491	300	279	329
„ 13th	634	498	136	320	336
„ 20th	606	477	129	284	278
„ 27th	698	470	228	283	291
November 3rd	668	443	225	295	303
„ 10th	623	449	174	247	346
„ 17th	704	462	242	238	286
„ 24th	760	446	314	296	301
December 1st	772	457	315	356	331
„ 8th	1,051	460	591	370	355
„ 15th	1,310	470	840	321	333
„ 22nd	1,416	470	946	299	305
„ 29th	1,853	469	1,384	282	317
January 5th	1,711	494	1,217	232	320
„ 12th	1,638	484	1,154	206	341
„ 19th	1,758	501	1,257	138	257
„ 26th	1,721	518	1,203	132	323
February 2nd	1,645	526	1,119	85	313
„ 9th	1,911	540	1,371	98	294
„ 16th	1,728	569	1,159	71	284
„ 25th	1,650	542	1,108	49	271
March 2nd	1,484	546	938	57	292
„ 9th	1,326	544	782	109	284
„ 16th	1,258	534	724	97	253
„ 23rd	1,139	539	600	37	270
„ 30th	1,141	544	597	89	240
April 6th	1,007	559	448	92	281
„ 13th	970	572	398	60	243
„ 20th	836	614	222	81	261
„ 27th	671	625	46	117	263
May 4th	638	606	32	133	295
„ 11th	558	599	...	156	291
„ 18th	547	602	...	173	269
„ 25th	541	581	...	159	276

TABLE VIII.

The details of 27 Patients treated at Parel Plague Hospital with M. Yersin's Anti-toxic Serum.

No.	Initials.	Sex.	Age	Caste.	Occupation.	Duration of Disease.	Serum in C. C.	Total C. C.	Result.	REMARKS.
						Days.				
1	C. D. N.	M	51	N. C.	Medical Practitioner.	4—5	30+20	50	D	Double pneumonia.
2	D. P.	F	40	H.	Cooly . .	2	30+20	50	D	
3	D. N.	F	14	N. C.	...	2	10+10+10	30	R	
*4	R. T. N.	F	18	N. C.	...	3	20+20	40	D	Meningitis and tumour (osseous pressing on medulla in P. M.)
5	S. B.	M	24	H.	Clerk . .	3—4	20+10+10+20	60	D	
6	S. B. K.	M	18	H.	Mill-hand .	3—5	20+10	30	D	
7	P. D.	F	60	H.	...	2	30+30+40	100	D	
8	R. M.	M	25	H.	Mill-hand .	2	30	30	D	
9	J. D. D. S.	M	13	N. C.	School-boy .	36 hours.	40+40	80	D	Developed pneumonia double.
10	P. R.	M	7	H.	Do. .	2	30+30	60	R	
*11	R. F.	F	25	N. C.	...	...	20	20	...	
12	M. D.	M	30	H.	Hamal . .	2	40	40	D	
13	R. M.	M	9	N. C.	School-boy .	1	40+40+40+40+30	190	R	
14	S. J.	M	9	H.	Sweeper .	2	40+40+30	110	R	
15	B. J.	M	25	H.	Do. .	2	30+40+40	110	R	
16	B. G. S.	M	28	H.	Clerk . .	36 hours.	40+50	90	D	
17	T. M.	M	18	H.	Mill-hand .	3	50+50+50+50+30	230	R	
18	M. S.	M	30	H.	Mali . .	26 hours.	40	40	D	
19	K. H.	M	22	H.	Massal . .	4—5	40	40	R	
20	L. R.	F	12	N. C.	...	3—9 hours.	40	40	D	
21	A. K. T.	M	60	N. C.	Merchant .	9 hours.	40+50+50	140	R	
22	M. E.	M	45	Parsee.	Cook . .	3	60	60	R	
23	D. E.	F	11	Parsee.	...	27 hours.	50	50	D	
*24	H. B.	F	32	Hindu	...	7 „	50	50	R	I heard came from Charni Road Hospital.
25	C. M.	F	32	N. C.	...	24 „	50+50	100	D	
26	K. B. S.	F	4	H.	...	42 „	40	40	D	
27	G. R.	M	52	H.	Clerk . .	3—5	20	20	D	Hepatitis and R. Ferri injected at his own urgent request.

* These were not cases of plague.

Case No. 4 died of meningitis and should be excluded and mortality = 60·8 per cent.

2 cases developed sub-acute synovitis.

2 cases developed erythematous rashes on the skin. In one of these the rash persisted 2½ weeks.

TABLE

Showing the results of the quantitative urine analyses obtained by Surgeon-Captain

1 No.	2 Race.	3 Age.	4 Sex.	5 Day.	6 Quantity.	7 Colour.	8 Re-action.	9 Sp. Gr.	10 Urea.	11 Chlorides.	12 Sulphates.	13 Phosphates.	14 Solids, Grm per diem.
1	E.	34	F	4	700·C. C.	Muddy Yellow.	Faintly acid	1,015	2%	Trace.	P	D	25·46
2	Eurasian.	36	M	3	760·C C.	Reddish Brown.	Sharply acid.	1,025	1·85%	Do.	P	D	44·27
3	D. E.	18	M	3	800 C C.	Light Yellow.	Do.	1,018	1·75%	Absent.	P	D	35·55
4	Eurasian.	22	M	5	630·C.C.	Brown Red	Do.	1,020	1·75%	Trace.	P	D	29·35
5	Do.	21	M	4	760·C C.	Pale Yellow	Do.	1,024	1·85%	Absent.	Trace.	Faint.	42·49
6	E.	52	M	3	900·C.C.	Red Yellow	Do.	1,015	2·5%	Present.	P	D	31·45
7	R. J.	36	M	4	800·C C.	Do.	Intensely acid	1,026	1·85%	Trace.	P	D	48·46
8	D. E.	9	M	4	900·C.C.	Yellow Red	Alke	1,022	1 85%	Do.	P	Abundant.	46·13
9	E. J.	29	M	3	800·C.C.	Red Yellow	Sharply acid	1,015	2·0%	Absent.	Trace.	D	27·96
10	E. J.	31	M	4	760·C.C.	Do.	Neutral	1,018	1·85%	Trace.	Marked P	D	31·87
11	N. C.	18	M	4	800·C.C.	Light Yellow.	Sharply acid	1,025	0·85%	Absent.	P	D	46·60
12	Eurasian.	45	M	3	850·C.C.	Red Yellow	Do.	1,025	1·80%	Do.	P	D	49·51
13	Do.	22	M	5	1,000·C.C.	Dark Red	Do.	1,028	1·75%	Trace.	P	D	63·04
14	Do.	23	M	4	850·C.C.	Yellow Red	Do.	1,018	1·25%	Do.	P	Present.	35·64
15	Do.	15	F	4	800·C.C.	Red	Do.	1,015	2·5%	Do.	P	D	27·96
16	G.	34	M	3	760·C.C.	Deep Red	Do.	1,024	1·85%	Absent.	P	D	42·49
17	Eurasian	26	M	3	600·C.C.	Red Yellow	Do.	1,025	1·75%	P. Trace.	Trace.	D	34·95
18	D. E.	38	M	9	700·C.C.	Red	Do.	1,025	1·90%	Absent.	P	Trace.	40·77
19	Eurasian	13	M	4	400·C.C.	Muddy Yellow Red.	Faintly acid	1,020	2·0%	Trace.	P	D	18·64
20	Do.	29	M	4	650·C.C.	Do.	Sharply acid	1,018	1·5°/o	Absent.	P	D	27·26
21	Do.	9	M	5	1,000·C.C.	Light Yellow.	Do.	1,015	2·5%	P.	P	D	34·95
22	G.	44	M	3	700·C.C.	Do.	Do.	1,020	1·85%	Trace.	P	D	32·62
23	G.	14	M	3	500·C.C.	Yellow Red	Do.	10,24	2·0%	Do.	P	D	27·96
24	D. E.	18	M	4	950·C.C.	Red Yellow	Do.	1,014	2·5%	Do.		D	30·98
25	G.	16	M	5	1,000·C·C.	Yellow Red	Do.	1,018	1·85%	Do.	Slight.	D	41·94
26	Eurasian.	15	M	6	800·C.C.	Do.	Do.	1,010	1·0%	Do.	P	D	18·64
27	G.	26	M	4	800·C.C.	Red Yellow	Do.	1,012	1·85%	Do.	P	D	20·26
28	D. E.	31	F	3	850·C.C.	Do.	Do.	1,016	1·90%	Do.	P	D	31·68
29	D. E.	7	M	4	630·C.C.	Do.	Do.	1,015	2·25%	P.	P	D	22·01
30	D. E.	8	F	4	900·C.C.	Yellow Red	Do.	1,018	2·0%	Trace.	P	D	39·84
31	Eurasian.	30	M	3	800·C.C.	Light Yellow.	Do.	1.025	1·85%	Do.	P	D	46·60
32	D. E.	22	F	4	900·C.C.	Yellow Red	Do.	1,024	2·5%	P.	P	D	50·32
33	Eurasian.	21	M	4	1,000·C.C.	Light Yellow	Faintly acid	1,010	1·75°/o	Trace.	P	Trace.	23·30
34	Do.	55	M	5	1,500·C.C.	Red Yellow	Sharply acid	1,025	1·75°/8	P.	P	D	87·37
35	G.	22	M	3	760·C.C.	Brown Red	Intensely acid	1,026	2·75°/8	Absent.	P	D	46·04
36	Eurasian.	32	M	5	1,400·C.C.	Yellow	Sharply acid	1,022	1·50°/o	Do.	P	D	71·76
37	Do.	19	F	5	1,000·C.C.	Do.	Do.	1,025	2·0%	Trace.	P	D	58·25
38	J.	20	M	5	1,500·C.C.	Brown Red	Do.	1,024	2·0°/o	Absent.	P	D	82·88
39	Eurasian.	18	F	3	500·C.C.	Do.	Do.	1,025	2·5°/o	Trace.	P	Trace.	29·12
40	Do.	33	M	4	1,260·C.C.	Light Yellow.	Do.	1,030	2·5°	Do.	P	P	88·07
41	Do.	17	M	4	900·C.C.	Do	Intensely acid	1,024	1 25°/o	Do.	P	Slight.	50·32
42	G.	44	M	5	950·C.C.	Red Yellow	Sharply acid	1,026	1·75°/o	Trace Salmon Pink.	P	D	57·45
43	J.	40	M	4	950·C.C.	Do.	Do.	1,035	1·25%	Trace.	P	D	77·48
44	European.	17	F	3	800·C.C.	Light Yellow.	Do.	1,025	1·50%	Fair.	P	D	46·60
45	R. J.	26	F	4	900·C.C.	Red Yellow	Do.	1,032	2·25%	Trace.	P	Slight.	67·10
46	J.	16	M	4	1,000·C.C.	Red Brown	Do.	1,025	2·0%	Do.	P	Do.	58·25
47	Eurasian.	12	M	5	1,200·C.C.	Light Yellow.	Neutral	1,018	2·5%	P.	P	Abundant.	50·32
48	Do.	28	M	5	1,600·C.C.	Red Yellow	Do.	1,018	3·2%	D.	P	D	67·10
49	D. E.	13	M	4	760·C.C.	Do.	Sharply acid	1,028	2·5%	Normal.	P	Slight.	49·55
50	Eurasian.	42	F	4	700·C.C.	Do.	Do.	1,020	2·5%	Trace.	P	Do.	32·62

Abbreviations—E. — European. D. E. — Domiciled European. E. J. — European Jew. J. — Jew. R. J. — Russian Jew.

App. xiv.

X

Hojel in fifty plague cases at the St. George's Hospital, Bombay.

15 Albumen.	16 Globulins.	17 Peptones.	18 Albumoses.	19 Bile.	20 Sugar.	21 Indican.	22 Leucin, Tyrosin.	23 Acetone, Diacetic Acid.	24 Diazo Reaction.	25 Sediment.
Trace.	*Nil.*	*Nil.*	*Nil.*	Trace.	*Nil.*	Trace.	*Nil.*	*Nil.*	Port wine colour .	Amorphous urates ; no casts.
Do.	,,	,,	,,	Do.	,,	Do.	,,	,,	Do. .	No casts.
Do	,,	,,	,,	*Nil.*	,,	Marked.	,,	,,	Do. .	Do.
Do.	,,	,,	,,	,,	,,	M	,,	,,	Do. .	Hyaline and uratic casts ; uric acid crystals abundant.
Nil.	,,	,,	,,	Trace.	,,	M	,,	,,	Do. .	No sediment ; mucous clouds.
,,	,,	,,	,,	*Nil.*	,,	Trace.	,,	,,	Do. .	Cloudy ; no sediment.
Trace.	,,	,,	,,	,,	,,	M	,,	,,	Do. .	Cloudy.
Do.	,,	,,	,,	,,	,,	M	,,	,,	Do. .	Amorphous and triple phosphates.
Nil.	,,	,,	,,	,,	,,	M	,,	,,	Do. .	Amorphous urates ; uratic casts.
Trace.	,,	,,	,,	,,	,,	M	,,	,,	Do. .	Urate of ammonium.
¼	Trace	,,	Present.	,,	,,	Trace.	,,	,,	Do. .	Granular casts, large and small urate of ammonium.
6	Do.	,,	P	,,	,,	M	,,	,,	Do. .	A few granular casts.
Trace.	*Nil.*	,,	*Nil.*	Trace.	,,	Fair.	,,	,,	Light Port wine colour.	Do. do.
Nil.	,,	,,	,,	Do.	,,	M	,,	,,	Port wine colour.	*Nil.*
⅛	Trace.	,,	P	*Nil.*	,,	M	,,	,,	Do. .	R. B. corpuscles ; hæmoglobin crystals.
¼	Do.	P	P	,,	,,	M	,,	,,	Do. .	Do.
¼	Do.	*Nil.*	P	,,	,,	Trace.	,,	,,	Do. .	R. B. corpuscles ; amorphous urates.
½	*Nil.*	,,	P	Trace.	,,	Marked.	P	Acetone	Do. .	Granular casts.
Trace.	,,	,,	*Nil.*	*Nil.*	,,	Trace.	*Nil.*	*Nil.*	Do. .	Epithelial casts.
Do.	,,	,,	,,	,,	,,	Marked.	,,	,,	Do. .	*Nil.*
Nil.	,,	,,	,,	,,	,,	Fair.	,,	,,	Do. .	,,
,,	,,	,,	,,	,,	,,	M	,,	,,	Light P. W.	,,
Trace.	Trace.	,,	,,	,,	,,	M	,,	,,	P. W.	,,
Nil.	*Nil.*	,,	,,	,,	,,	Trace.	,,	,,	Do. .	,,
,,	,,	,,	,,	Trace.	,,	M	,,	,,	Do. .	,,
,,	,,	,,	,,	*Nil.*	,,	Trace.	,,	,,	Do. .	,,
,,	,,	,,	,,	Trace	,,	Marked.	,,	,,	Do. .	Urate of soda.
Trace.	,,	Trace.	,,	*Nil.*	,,	Trace.	,,	,,	Do. .	Amorphous urates.
Nil.	,,	*Nil.*	,,	,,	,,	M	,,	,,	Do. .	*Nil.*
Trace.	,,	,,	,,	Trace.	,,	M	,,	,,	Do. .	Vaginal epithelium ; no casts.
Do.	,,	,,	,,	*Nil.*	,,	M	,,	,,	Do. .	Amorphous urates.
Nil.	,,	,,	,,	Trace.	,,	M	,,	,,	Do. .	Vaginal epithelium ; urates.
Trace.	,,	,,	,,	*Nil.*	,,	M	,,	,,	Do. .	Urate of ammonium.
¼	,,	,,	,,	Trace.	,,	M	,,	,,	Do. .	Granular and epithelial casts.
¼	Trace.	,,	Trace.	*Nil.*	,,	M	,,	,,	Do. .	Uric acid.
½	*Nil.*	Trace.	Do.	,,	,,	M	,,	,,	Do. .	Hyalin casts.
⅙	,,	*Nil.*	Do.	,,	,,	M	,,	,,	Do. .	*Nil.*
⅛	,,	,,	Do.	,,	,,	M	,,	,,	Do. .	Amorphous urates.
Trace.	,,	,,	*Nil*	,,	,,	Trace.	,,	,,	Do. .	Epithelial casts.
Do.	,,	,,	,,	Trace.	,,	M	,,	,,	Do. .	*Nil.*
Do.	,,	,,	,,	*Nil.*	,,	M	,,	,,	Do. .	Uric acid ; oxalate of lime.
Do.	,,	,,	,,	Trace.	,,	M	,,	,,	Do. .	Amorphous urates.
½	Trace.	,,	Trace.	*Nil.*	,,	Trace.	,,	,,	Do. .	Granular and uratic casts.
Trace.	*Nil.*	,,	*Nil.*	P.	,,	Do.	,,	,,	Do. .	Vesical and vaginal epithelium.
Do.	,,	,,	,,	Trace	,,	M	,,	,,	Do. .	*Nil.*
Do.	,,	,,	,,	*Nil.*	,,	M	,,	,,	Do. .	Granular casts.
Nil.	,,	,,	,,	,,	,,	M	,,	,,	Do. .	Triple phosphates.
⅙	,,	,,	P	,,	,,	M	,,	,,	Do. .	*Nil.*
Nil.	,,	,,	*Nil.*	Trace.	,,	M	,,	,,	Do. .	,,
¼	,,	,,	Trace.	*Nil.*	,,	Trace.	,,	,,	Do. .	Uratic casts.

G = Goanese. N C = Native Christian. P = Present. D = Diminished. M = Marked.

APPENDIX No. XV.

REPORT ON

PREVENTIVE INOCULATION AGAINST PLAGUE IN HUBLI FROM 11TH MAY TO 27TH SEPTEMBER 1898.

BY

CAPTAIN LEUMANN, I.M.S.

Widal's Test and Durham's Test in typhoid fever, etc.

I. In such diseases as typhoid fever and cholera, if the serum taken from the blood of a patient who has recently recovered from an attack, or from an immunized animal, be added to virulent bacilli of the disease, certain phenomena, characterized chiefly by the agglomeration and precipitation of these bacilli, and their consequent destruction, are capable of being demonstrated. The agglomeration can easily be seen on a slide under the microscope and, in honour of its discoverer, is known as Widal's test; while the precipitation reaction, first enunciated by Durham, can be demonstrated in either a capillary tube (Wright of Netley) or small test tube (Pfeiffer); and both these tests are also readily obtained when the serum taken from a patient convalescing or recently recovered from plague is added to virulent test bacilli.

Both these tests are capable of being shown in plague, and

can also be obtained with Yersin's serum.

Yersin's curative serum, obtained from horses after they have been inoculated with successively large doses of plague bacilli, also shows this result; and Wright's inoculation against typhoid fever will, after the febrile reaction caused by it has passed off, present in the serum taken from the blood of the person inoculated, a similar "bactericidal" reaction with typhoid bacilli—(*i.e.*, the bacilli of that disease are destroyed by such serum).

The serum from a well "Haffkinized" person will also exhibit Widal's Test.

II. Arguing by analogy, I endeavoured over a year-and-a-half ago to prove that the serum of a person recently "Haffkinized"—*i.e.*, protected by Mr. Haffkine's method against plague—would also be bactericidal to test bacilli, and thus afford a practical demonstration of the actual protective value of such inoculation: but although I experimented with the serum from several persons inoculated by Haffkine's staff, I failed at first to obtain such reaction. Somewhat later, however, I did find in the serum taken from a "Haffkinized" monkey, and also in the serums from persons who had been twice-inoculated, similar bactericidal properties against virulent plague bacilli to those met with in the serum of persons who had recovered from the disease. I did not, indeed, obtain these reactions in every case, but in a goodly number (and these had been twice inoculated with a full dose of the prophylactic each time within six weeks before I saw them); so I argued therefrom, rightly or wrongly remains to be proved, that it would be better, in inoculating natives against plague, to inoculate them twice within a comparatively short space of time and thus give them the fullest protection possible for a certain period—*e.g.* six months—which I considered such inoculation would be fully protective for.

My reasons for inoculating people twice, based on Widal's Test.

My reason for inoculating made public in Hubli.

III. Such, in short, is the method I have adopted in Hubli: and, in order to induce the inhabitants thereof to present themselves for inoculation, I drew up at the very outset certain rules (to be found below) which were freely circulated in printed form and proclaimed by beat of drum throughout the town.

NOTICE.

It is hereby notified that inoculation with Anti-Plague fluid will be carried out twice a week, on Tuesdays and Fridays, at the Civil Hospital, at 8 A.M., punctually.

This inoculation process appears to have been most successful elsewhere in protecting people against the Plague.

Persons able to show certificates of having been inoculated twice within six months will be exempt from segregation and detention in Hubli, except for such short time as is necessary for the disinfection of their houses and property. By such means persons from an infected area will derive the following benefits:—

1. They will remain 2 or 3 days only instead of 15 days in the Health Camp.
2. If desirous of going elsewhere than to the Health Camp, this will be allowed them after they and their kit have been disinfected.
3. They will more readily be able to obtain passes to leave Hubli for purposes of trade, etc.
4. They will be less liable to be detained in other districts.

HUBLI, B. H. F. LEUMANN,
28th April 1898. *Surgeon-Captain.*

Intention of method of inoculation.

V. My intention was to inoculate a person, say, on the first of the month and re-inoculate him on some date between the 20th and 30th of that month, but owing to the people crowding up for inoculation in order to obtain certificates of having been inoculated twice and, thereby, exemption from being turned out of their homes into the Health and Segregation Camps, I soon found it impossible to pursue my original plan, and many persons were thus reinoculated far too quickly.

And how it was partly vitiated by the stupidity of the people.

VI. Further, many persons who experienced only a slight reaction at the first inoculation have, while incubating the disease, presented themselves for and obtained their second inoculation, and have died within a few days afterwards of plague. This has been one of the factors whereby my comparative results between the once and twice-inoculated have been vitiated; another, the extraordinary persistence with which persons already affected with plague have come of their own accord, or been brought up—in spite of all warning to the contrary—for a second inoculation and by keeping well amongst the crowd of inoculation-seekers have, in some cases, actually managed to receive it. The more ignorant classes, moreover, have been known to bathe their plague-stricken children in cold water outside my office compound or other place where I have been inoculating, in order to lower their temperatures and in the hope of inducing me to administer a second dose of the prophylactic. These various factors should be carefully considered in reading over this report which, conclusive as it is of the actual value of inoculation in protecting the individual, and even the community, would have shown even better results had the people co-operated with me in a more intelligent manner than they did.

The dosage of Haffkine's prophylactic that I have adopted in Hubli.

VII. At the outset of my inoculation work here, I adopted the ordinary dosage written or printed on the labels on the bottles of lymph supplied to us direct from M. Haffkine's Laboratory in Bombay: but I soon discovered that in many cases the reaction after such a dose was too slight and of too short a duration to be of any great protection; and it is, indeed, largely amongst my earliest inoculated that many of the deaths, due to insufficient protection, have occurred, although many others—more recently inoculated with the weaker varieties of the "lymph"—have also succumbed to plague, some being attacked before the "inoculation fever" had passed off. The dosage of the prophylactic that I have employed has been rather greater than that stated on the bottles ; and in those who have been twice-inoculated the full amount of this increased dosage has been given at each inoculation. Early in the epidemic I wrote to Mr. Haffkine saying that I did not consider the reaction, in many cases obtained by his dosage, was sufficient, and he very courteously replied that he would leave the matter in my hands entirely and allow me,—by observation of the reactions obtained,—to increase or decrease the dose of the different supplies forwarded me that I would give. Our method was to make control observations with certain bottles of the different supplies sent us on people in our segregation camp, whom we had under close surveillance, while the remaining bottles were used in the larger inoculation-meetings held in the town. Our conclusions are that, making full allowance for idiosyncrasies and "personal equations" of the persons inoculated, "lymphs" of the same stated dosage, though of different brews, varied at times ; and that this variance in the reactions obtained may possibly be due to alterations in the virulence of the cultures from which the different brews are prepared and possibly also to differences in the composition of the culture media used in their preparation. On the whole, I consider that the stronger the lymph the greater its protective power becomes ; and, although weaker lymphs may sometimes produce greater evidences of local reaction than stronger ones, I attach far more importance to the general reaction, *e.g.*, fever, headache, malaise, etc., as affording the best indication of the protection obtained.

The full amount given at each inoculation. No half-dosage ever employed in Hubli.

Variations in the reactions of lymph of the same stated dosage. Reasons suggested as possible causes for this result.

No half doses of the prophylactic have ever been employed in Hubli : the dosage, with very few exceptions indeed, has always been increased, and a full dose given at each inoculation, allowance being duly made for age, sex, general physique, etc., where needed.

Method pursued with regard to inoculated persons living in infected areas.

VIII. Inoculated persons holding certificates of double inoculation have, at my special wish and order, been left in their homes throughout this epidemic ; only their clothes, house and property being disinfected on the occurrence of a plague case or death in their house. As the vast majority of plague cases have never been notified before death in Hubli (nor, in my experience of nearly two years, elsewhere if native supervision be largely resorted to), it will readily be understood that the majority of the inoculated have actuallly been living in the same house, or even room, with a plague case (often of the pneumonic type whose terrible power of spreading the disease was first shown by Professor Childe, I.M.S., of Bombay) during the whole of the time that case was living, probably attending on the patient, breathing the same stuffy air, and, perhaps, sharing the same blanket ; and I attach at the end of this report a long series of cases where such conditions have occurred, the non-inoculated dying of plague and the inoculated escaping, almost to a man.

Further, the inoculated have not been segregated as the uninoculated have been, but allowed to remain in their own quarter in the most infected areas, with what immunity as a result, the figures quoted below will show.

The inoculated inhabitants of Hubli, in spite of the privileges allowed them to do so, did not leave the town in such large numbers as the non-inoculated.

IX. Various critics on my work, not knowing what the actual facts were and are, have at different times asserted that the inoculated inhabitants of Hubli left the town in larger numbers than the non-inoculated. This idea was not altogether unnatural since "passes by rail and road" were not granted to uninoculated persons, but is, nevertheless, wholly erroneous, for, as a census of Hubli was taken weekly, it was a comparatively easy matter to compare the number of inoculated and non-inoculated amongst its inhabitants at any stage of our operations, and by such a method alone we were able to show that exactly the reverse was the case. Further, the one great complaint all classes and castes of Natives raised against general measures was that, if not inoculated, they were turned out of their houses and sent to the different camps ; hence the concessions granted to those who held inoculation certificates of having been twice inoculated induced large numbers to undergo the process in order to remain in their houses, and these—finding themselves practically immune and left alone, while their non-inoculated neighbours either died of plague or were segregated promptly on the occurrence of a plague death in their midst or a plague patient being found amongst them—had neither any wish to leave their homes, where they felt safe, nor, still more, to forsake their only means of livelihood by running away from town. The British Officers on plague duty here and all the Divisional Superintendents invariably replied (officially and in writing when so required) that the non-inoculated had left Hubli in far greater numbers and portion than the inoculated, and my own observations entirely bear out this statement. One Divisional Superintendent on the 22nd of August even affirmed in writing that, although a large number of the people in his area had been inoculated, not one of them had left Hubli !

The value of granting concessions to the inoculated, as compared with the flight of the non-inoculated.

X. As the most stringent orders have been issued by the Collector of Dharwar, at various times, to prevent the inhabitants of Hubli, by their flight, infecting other towns and villages, the value of the fact that the inoculated who (being twice inoculated) are allowed to leave their homes, if they wish to, have not done so to any appreciable extent, but continue to live quietly in them, while most of the uninoculated have run away, panic-stricken, in utter disregard to all orders, cannot be overestimated.

The people have thoroughly understood the actual protective value of inoculation.

XI. There is no doubt that the people of Hubli who at first only came up for inoculation in order to escape segregation, etc., have now thoroughly learnt to appreciate its protective value, for they have presented themselves, by the hundred, at all times of the day before myself and others, for the purpose of being inoculated.

The results obtained attributable to the methods pursued.

XII. I attribute these results to the methods I have adopted in Hubli in order to gain the confidence of its inhabitants. When I began my inoculations, I operated first of all on some European or native gentleman in front of a crowd of poor and low-caste people, whom I had gathered together in the worst-affected area, and they were thus soon induced to ask for inoculation themselves. As I handed each man his inoculation ticket, I impressed him with the idea that, being twice-inoculated, he was protected against plague for six months as far as it was possible for me to protect him, and further explained that he was exempted from certain plague rules which others, who were not inoculated, were obliged to undergo. Later on, when I collected a large crowd for inoculation, after inoculating about 90 per cent. of their number, I left the remainder to form a nucleus for a fresh start on the following day, and by this method I succeeded in always obtaining large numbers to work upon. Later, again, I caused notices to be printed in English and Kanarese and placarded all over the town stating where and when I and my staff would inoculate morning and evening : and since the earlier part of August such numbers have presented themselves at this office at inconvenient hours that I have frequently been obliged to call upon the police to drive the people away.

The value of inoculation as a protective measure against plague influences villagers from far off to voluntarily seek it.

XIII. Since about the 10th of August people from the surrounding villages have come into Hubli for a few hours daily seeking inoculation. A separate record of inoculation has always been kept for persons who are not actual inhabitants of Hubli, so that neither these nor any other persons (*e.g.*, Sub-Assistant Surgeons from the Mysore or Madras side) have ever been included in our list of inoculations for Hubli itself.

No difficulty in inoculating purdáh women in Hubli.

XIV. I have never experienced the slightest difficulty in inoculating Mussalman or any other purdáh women in Hubli. From the very start I did all I possibly could to induce the people to place confidence in my staff and myself and other inoculators here : and I would draw attention to the fact that the very men who, in March last, created a disturbance in Hubli were not only the first and the most willing to undergo inoculation, but also to bring their wives and families to my hospital or to invite me to their homes to inoculate them.

Date of my first inoculations in Hubli.

XV. I first started inoculation here on May 11th. Some 150 to 200 persons had been inoculated in the earlier part of this year by Surgeon-Major Collie, M.B., C.M., who was then Medical Officer on Plague Duty in Hubli. I have not included this number amongst our own inoculations, but have included the few of their number that have since died from plague in our "deaths amongst inoculated persons."

An error in previous weekly reports corrected.

XVI. About one month and-a-half ago I found, on close investigation, that the number of deaths from plague, as recorded weekly amongst the once-inoculated previous to August 9th, was too low: nor had any proper account been taken of deaths other than plague in inoculated persons. This is a clerical error which has now been corrected, and I notified the fact in my report to Government, through the Collector of Dhárwár and the Surgeon-General, Bombay, for the week ending 30th August 1898.

My system in inoculating and registering inoculees.

XVII. The system we have pursued in inoculation work in Hubli is this:—Before a person is inoculated, his left arm is well swabbed over with 5 per cent. carbolic acid lotion; and our needles are carefully washed through and over with the same kind of lotion before and after each inoculation. The first injection is given into the loose subcutaneous tissue over the anterior part of the left upper arm just below the insertion of the Deltoid muscle: the second into the loose subcutaneous tissue over the Triceps muscle posteriorly, somewhat higher up than the former, in the same arm. By this means, only one arm is temporarily placed *hors de combat*, a very great consideration, in my opinion, for those who have to work hard with their hands. At the first inoculation a ticket, bearing the number and private mark of the register-book, into which the name, age, sex, caste, birth-place, present residence, occupation, etc., of the person inoculated is entered, is handed to each individual. At the second inoculation this ticket is taken back from him and an inoculation certificate of "twice-inoculation," bearing our book and number marks, made out in its place which, after receiving my signature, is handed over to the applicant for it, provided that his description of himself as to name, age, sex, caste, occupation, etc., etc., tallies in every detail with that given at the first inoculation and entered in our register.

Method of granting inoculation certificates.

Death registration and death-certificates. Method pursued in Hubli for finding out whether a person has been inoculated or not before, when attacked by any disease or dying from any cause whatsoever.

XVIII. For several months past, and before I came to Hubli, a rule has been in force that every death, whether from plague or other causes, must be certified as to its actual cause by one of the two Government subordinates (Assistant Surgeon and Hospital Assistant), whose sole duty is the inspection of cases and corpses. In each instance they enquire and search for evidence of inoculation, and if no certificates or ticket be obtained, then they examine the left arm for traces (*e.g.*, nodes of thickened subcutaneous tissue) of previous inoculation. All statements concerning the case or corpse having been inoculated are at once carefully investigated. The names of all the inhabitants of Hubli were registered in a new census soon after my arrival, ward by ward, street by street, and house by house, and any later change of residence has also been duly noted, so that there is and has been no real difficulty in at once identifying the vast majority (over 95 per cent.) of corpses. These registers have also been checked by Lieutenants Keelan and Thomas, on plague duty here, and the work of my own subordinate inspecting staff is thus counter-checked by these officers. If a certificate of twice-inoculation or a ticket of once-inoculation be obtained, it is at once taken possession of and filed in my office: besides this, all names are looked up in my inoculation registers. I consider this method to be as accurate as is possible, and no corpse can be burnt or buried without inspection by the subordinates I have appointed or—in the case of the Southern Maratha Railway Company's employés living within railway limits—by the two medical officers in the Southern Maratha Railway Company's service. The same method is pursued with regard to attacks from plague, and reference is at once made to our registers. We have been able to trace all cases and deaths from plague, amongst inoculated persons, that have come under our notice in this way, and I am strongly of the opinion that any which may not have been so noted do not number more than 5 per cent. of the whole.

Ages of youngest and oldest inoculees.

Children bear inoculation well.

XIX. The youngest person I have inoculated in Hubli was an infant aged 10 days only: and the oldest a woman whose age was stated as 96 and must have been, certainly, between 85 and 90. My experience is that children stand inoculation better than adults and can be given proportionately larger doses: women appear to exhibit severer local reactions than men—probably because their arms are more fatty,—but I have not observed much difference in the "general reaction" between the two sexes. I am inclined not to inoculate women if within their last three weeks of pregnancy—(although I have done so without ill effect)—in case the severity of the reaction after inoculation may be so great as to cause a miscarriage or premature birth: but I have inoculated several women who were quite seven months advanced in their pregnancy and, provided the woman's health be good, I see no reason why she should not receive a modified dosage.

Inoculation in pregnant women.

Inoculation in the incubation period of plague.

XX. An important question arises—"Should a person who may be incubating plague undergo inoculation?" My opinion, based on a large experience, is that although in the very early stages of a comparatively long incubation period inoculation may benefit, yet in a short incubation period or in one which is well advanced, it is far more likely to be harmful. Further, it must be remembered that it is impossible, before actual symptoms develop, to be in any way certain whether the incubation period will be long or short, even though a pretty accurate guess may be hazarded that a given person is actually in the incubation stage of plague. Much, moreover, depends on the virulence of the epidemic, the incubation period certainly appearing to be longer, for instance, when the strength of an epidemic is on the wane. Hence I consider it advisable never to inoculate a person if he be found suffering from "fever" of over 100° Fahr.—more especially if he be an actual contact from a plague case or corpse—in case that "fever" might be indicative of incipient plague (*i.e.*, at the end of the incubation period of the disease or even slightly beyond this).

A rough rule for guidance when not to inoculate a person during a plague epidemic.

Inoculation apparently protective against diseases other than plague.

XXI. One peculiar fact which our inoculation results in Hubli exhibited was that not only were the inoculated protected from plague, but their general health was also better, as shown by their low death-rate "from other causes." I do not desire, however, to attach undue importance to this fact, for it is more than likely that while every inoculated person who died from plague was brought into immediate prominence by reason of the failure of the prophylactic to protect him, such searching enquiry was not, on the other hand, made when every non-inoculated person died from the same disease, and some deaths amongst this latter class—really due to plague, but exhibiting no external buboes or other signs and concerning whose illness no history was forthcoming—were wrongly attributed to "causes other than plague." Not only was everyone on the "*qui vive*" to point out any inoculated person who had subsequently died from plague (or any other cause), but also—in order to obtain the fullest truth and information in the matter—I encouraged everybody, high and low, European and native, to bring all such cases to our notice at once. When once they have been induced to place reliance in a method, natives, in my experience, fly to extremes and imagine that method to be infallible: hence the fact that practically every case of non-protection against plague after inoculation was brought up by the friends and relations as if they had a grievance against the method for not being absolutely certain to protect each and every person inoculated.

People when they once believe in inoculation often imagine it to be infallible.

Inoculation seems to benefit pustular eczema,

but to aggravate lupus

and tubercular diseases.

XXII. I have frequently noticed that Haffkine's inoculation benefits certain diseases or symptoms while it appears to aggravate others. For instance:—Eczema, especially of the pustular variety, frequently improves and sometimes disappears after inoculation. Lupus, on the other hand, in four cases that I noted, was greatly aggravated. I have also noticed that a troublesome cough, often lasting 4—5 weeks, has followed inoculation in persons of poor physique especially (who might be tubercular subjects?); and in a few cases of undoubted tubercle of the lungs I have noticed, besides an aggravation of the cough, an increase of hectic temperature and early morning sweats, occasionally lasting for weeks. All these people recovered completely, however: but I cannot help thinking that inoculation aggravated their condition temporarily. I even been credited with having cured two cases of epilepsy in young men, who had been under treatment off and on for years, by inoculating them!

Statement showing the weekly census of Hubli and total number of its inhabitants inoculated up to corresponding dates.

XXIII. I append below the weekly census of Hubli and the total number of persons (actual inhabitants of the town) inoculated up to the corresponding dates, together with the number of non-inoculated residents remaining. No census was taken between May 1st and June 14th, so that the census for May 1st is quoted as that for May 11th. This, though not strictly accurate, is undoubtedly in favour of the non-inoculated and against the inoculated :—

DATES.	Census of Hubli.	Total number of inhabitants of Hubli inoculated up to dates corresponding with Census.
Five weeks { From 11th May 1898 To 14th June 1898	Fell* from 50,000 To 47,427	3,004
Week ending 21st June 1898	47,082	5,648
„ 28th June 1898	471,485	8,443
„ 5th July 1898	46,537	10,746
„ 12th July 1898	46,518	13,269
„ 19th July 1898	45,240	15,690
„ 26th July 1898	43,809	20,824
„ 2nd August 1898	43,707	22,727
„ 9th August 1898	42,768	27,837
„ 16th August 1898	40,441	31,273
„ 23rd August 1898	39,400	33,880
„ 30th August 1898	38,210	35,014
„ 6th September 1898	38,382	36,795
„ 13th September 1898	38,408	37,392
„ 20th September 1898	39,142	38,265
„ 27th September 1898	39,315	38,806

Corrected statement showing numbers of inoculated and non-inoculated present in Hubli on the dates corresponding with the census with plague deaths amongst them.

XXIV. As a matter of fact, the above figures are not quite representative, for no account has been taken of those inoculated persons who may have left the town. Allowing that the inoculated left Hubli week by week in the same proportion as the uninoculated (see paragraph X), no favour in prejudice of the inoculated is made when the above correction is entered as follows :—

DATES.	Census of Hubli.	Number of non-inoculated inhabitants.	Number of inoculated inhabitants.	Plague deaths amongst the non-inoculated.	Plague deaths amongst the inoculated.
Five weeks { From 11 May 1898 To 14th June 1898	Fell from 50,000 To 47,427	44,573	2,854	47	1
Week ending 21st June 1898	47,082	41,494	5,588	22	3

Dates.	Census of Hubli.	Number of non-inoculated inhabitants.	Number of inoculated inhabitants.	Plague deaths amongst the non-inoculated.	Plague deaths amongst the inoculated.
Week ending 28th June 1898	47,485	39,042	8,443	29	1
„ 5th July 1898	46,537	36,020	10,517	55	6
„ 12th July 1898	46,518	33,255	13,263	34	6
„ 19th July 1898	45,240	29,716	15,524	82	7
„ 26th July 1898	43,809	24,112	19,697	100	15
„ 2nd August 1898	43,707	21,031	22,676	140	16
„ 9th August 1898	42,768	15,584	27,184	272	19
„ 16th August 1898	40,441	10,685	29,756	386	61
„ 23rd August 1898	39,400	6,367	33,033	371	41
„ 30th August 1898	38,210	4,094	34,116	328	28
„ 6th September 1898	38,382	2,731	35,469	227	34
„ 13th September 1898	38,408	1,116	37,292	138	47
„ 20th September 1898	39,142	937	38,205	106	55
„ 27th September 1898	39,315	603	38,712	58	20

XXV. Calculating the plague death-rate per mille on the above table, for the uninoculated and inoculated, we arrive at the following results, which become perhaps more striking and apparent when we regard them in the light of percentage reductions (Column *a*).

Plague death-rate per mille amongst non-inoculated and inoculated compared with a per cent. reduction table on total results calculated from the foregoing table.

Dates.	PLAGUE DEATH RATE—COMPARISON PER MILLE BETWEEN		*a*
	Non-inoculated.	Inoculated.	Percentage reduction of death-rate from plague in favour of the inoculated.
Five weeks { From 11th May 1898 To 14th June 1898	1·022	·350	Over 65 per cent.
Week ending 21st June 1898	·530	·527	About 1 „
„ 28th June 1898	·742	·118	Nearly 85 „
„ 5th July 1898	1·524	·570	About 63 „

Dates.	PLAGUE DEATH RATE —COMPARISON PER MILLE BETWEEN		Percentage reduction of death-rate from plague in favour of the inoculated.
	Non-inoculated.	Inoculated.	
Week ending 12th July 1898	1 022	·452	Nearly 56 per cent.
„ 19th July 1898	2·793	·450	84 „
„ 26th July 1898	4·147	·761	82 „
„ 2nd August 1898	6·656	·705	89 „
„ 9th August 1898	17·325	·698	Over 96 „
„ 16th August 1898	33 694	2·083	94 „
„ 23rd August 1898	57 011	1·241	98 „
„ 30th August 1898	80 116	·820	98 „
„ 6th September 1898	83·112	·958	99 „
„ 13th September 1898	112 903	1·260	Over 99 „
„ 20th September 1898	113·127	1·439	Over 99 „
„ 27th September 1898	96·185	·517	Over 99 „

Similar comparison between the non-inoculated and those inoculated once only.

In the following two tables the comparison between the non-inoculated and once-inoculated and between the non-inoculated and twice-inoculated are considered separately, thus:—

b

Dates.	Number of non-inoculated in Hubli.	Number of once-inoculated in Hubli.	DEATHS FROM PLAGUE AMONGST		PERCENTAGES IN FAVOUR OF	
			Non-inoculated.	Once-inoculated.	Non-inoculated.	Once-inoculated.
Five weeks { From 11th May 1898 To 14th June 1898	} 44,573	2,323	47	*Nil.*	...	100 per cent.
Week ending 21st June 1898	41,494	3,363	22	2	nearly 17 per cent.	......
„ 28th June 1898	39,042	4,487	29	1	...	70 per cent.
„ 5th July 1898	36,020	5,057	55	3	...	64 „
„ 12th July 1898	33,155	5,974	34	4	...	40 „
„ 19th July 1898	29,716	6,565	82	1	...	96 „
„ 26th July 1898	24,112	9,386	100	6	...	84 „

Dates.	Number of non-inoculated in Hubli.	Number of once-inoculated in Hubli.	Deaths from Plague amongst		Percentages in favour of	
			Non-inoculated.	Once-inoculated.	Non-inoculated.	Once-inoculated.
Week ending 2nd August 1898 .	21,031	10,016	140	7	...	90 per cent.
„ 9th August 1898 .	15,584	11,339	272	5	...	95 „
„ 16th August 1898 .	10,685	10,265	386	30	...	93 „
„ 23rd August 1898	6,367	9,671	371	21	...	96 „
„ 30th August 1898	4,094	7,569	328	8	...	86 „
„ 6th September 1898 .	2,731	6,798	227	11	...	98 „
„ 13th September 1898 .	1,116	6,381	143	7	...	99 „
„ 20th September 1898 .	937	6,567	106	11	...	98 „
„ 27th September 1898 .	603	6,820	58	4	...	90 „

In only one week, then, was there any percentage in favour of the uninoculated, and so slight was it as to be practically ignored. A very similar result is also shown in the following table:—

Similar comparison between the non-inoculated and those inoculated twice.

y

Dates.	Number of non-inoculated in Hubli.	Number of twice-inoculated in Hubli.	Deaths from Plague amongst		Percentages in favour of	
			Non-inoculated.	Twice-inoculated.	Non-inoculated.	Twice-inoculated.
Five weeks { From 11th May 1898 . To 14th June 1898 .	} 44,573	531	47	1 {	44 per cent.	......
Week ending 21st June 1898 .	41,494	2,220	22	1	...	18 per cent.
„ 28th June 1898 . .	39,042	3,956	29	*Nil.*	...	100 „
„ 5th July 1898 .	36,020	5,460	55	3	...	64 „
„ 12th July 1898 .	33,255	7,289	34	2	...	72 „
„ 19th July 1898 .	29,716	8,959	82	6	...	75 „
„ 26th July 1898 . .	24,112	10,311	100	9	...	80 „
„ 2nd August 1898 .	21,031	12,660	140	9	...	85 „
„ 9th August 1898 .	15,581	15,845	272	14	...	95 „
„ 16th August 1898 .	10,685	19,491	386	31	...	96 „

DATES.	Number of non-inoculated in Hubli.	Number of once-inoculated in Hubli.	DEATHS FROM PLAGUE AMONGST		PERCENTAGES IN FAVOUR OF	
			Non-inoculated.	Twice-inoculated.	Non-inoculated.	Twice-inoculated.
Week ending 23rd August 1898 .	6,367	23,362	371	20	...	Over 98 per cent.
" 30th August 1898 .	4,094	26,547	328	20	...	96 "
" 6th September 1898 .	2,731	28,671	227	23	...	Over 99 "
13th September 1898	1,116	30,911	143	39	...	Over 99 "
" 20th September 1898 .	973	31,683	106	24	...	Over 99 "
" 27th September 1898 .	603	31,872	58	16	...	Over 99 "

If the three foregoing lists be compared, it will be found that the percentages given under the headings *b* and *y* of the two latter lists will, if added together, or subtracted from each other as occasion requires, give the percentages noted in column *a*.

Statement showing what the death-rate amongst the inoculated would have been had they died from plague in proportionate numbers to the uninoculated.

XXVI. From the foregoing tables the following is readily reduced.

Dates.	The death-rate from plague, if the inoculated had died in proportionate numbers, ought to have been	Instead of, as it actually was.
Five weeks from 11th May 1898 to 14th June 1898 . .	2	1
Week ending 21st June 1898	Remaining stationary at ...	3
" 28th June 1898	5	1
" 5th July 1898	15	6
" 12th July 1898	13	6
" 19th July 1898	42	8
" 26th July 1898	79	15
" 2nd August 1898	146	15
" 9th August 1898	489	19
" 16th August 1898	1,102	61
" 23rd August 1898	2,040	41
" 30th August 1898	2,624	28

Dates.	The death-rate from plague, if the inoculated had died in proportionate numbers, ought to have been	Instead of, as it actually was,
Week ending 6th September 1898	3,151	34
„ 13th September 1898	4,968	47
„ 20th September 1898	4,122	55
„ 27th September 1898	3,703	20

We thus see, perhaps more conclusively than in any other way, what the protective value of inoculation has been throughout this epidemic.

Comparison between the once and twice-inoculated.

XXVII. I append below a table comparing the results between those inoculated once and twice, with a percentage list in favour of each:—

Dates.	Number of inhabitants of Hubli inoculated once.	Number of inhabitants of Hubli inoculated twice.	Plague deaths amongst the once-inoculated.	Plague deaths amongst the twice-inoculated.	Comparison of totals between once-inoculated and twice-inoculated.		Percentage in favour of those inoculated once, twice.	
Five weeks from 11th May 1898 to 14th June 1898.	2,323	531	*Nil.*	1	*Nil.*	·0018	100	...
Week ending 21st June 1898.	3,368	2,220	2	1	·0006	·0001	...	33%
„ 28th June 1898 .	4,487	3,956	1	*Nil.*	·0002	*Nil.*	...	100%
„ 5th July 1898 .	5,057	5,420	3	3	·0009	·0009	practically equal	
„ 12th July 1898 . .	5,974	7,289	4	2	·0006	0002	...	66%
„ 19th July 1898 .	6,565	8,959	1	6	·0001	·0006	80%	...
„ 26th July 1898 .	9,386	10,311	6	9	·0006	·0008	25%	...
„ 2nd August 1898 .	10,016	12,660	7	9	·0006	·0007	14%	...
„ 9th August 1898 .	11,939	15,845	5	14	·0004	·0008	50%	...
„ 16th August 1898 .	10,265	19,491	30	31	·0028	·0015	...	45
„ 23rd August 1898 .	9,671	23,362	21	20	·0021	·0008	...	61
„ 30th August 1898 .	7,569	26,547	8	20	·0010	·0007	...	30
„ 6th September 1898 .	6,798	28,671	11	23	·0015	·0007	...	50
„ 13th September 1898	6,381	30,911	7	19	·0011	·0006	...	45
„ 20th September 1898 .	6,567	31,638	11	24	·0016	·0007	...	54
„ 27th September 1898 .	6,820	31,872	4	16	·0006	·0005	...	16

The total result of twice-inoculation as compared with once-inoculation is 10 per cent. in favour of the former, from Hubli experiences, but ought to be greater.

Now, we ignore those weeks in which there was "practically no comparison," because there were no actual figures to compare, and the week in which the percentages are "practically equal," we shall—if we add up the totals separately—arrive at 159 as the total for 4 weeks, of the once-inoculated, and 400 as the total for 9 weeks, of the twice-inoculated. Dividing each total by its respective number of weeks, we get nearly 40 and over 44 as representative ratio numbers, for the once-inoculated and twice-inoculated respectively, or as calculated by percentages of 90 to 100. That is to say, the twice-inoculated show a record just over 10 per cent. better than the once-inoculated. This appears rather low, but I have already explained in paragraph VI how it has been brought about by the stupidity of the people themselves. I consider that it ought to have been 18—20 per cent. instead of 10 per cent. as it stands.

Protection by inoculation amongst the employés of the Southern Mahrátta Spinning Company.

XXVIII.—In the Southern Mahrátta Spinning Company's Mill a series of experiments in inoculation were carried out at the express wish of the Manager, Mr. Narayenrao, who has kept careful records of all the inoculations done, and carefully checked out results. On the 21st of June there were 1,173 mill hands on the muster-roll. Of these 1,040 have since been twice-inoculated, with a death-rate from plague of 22 altogether, or 2·11 per cent.; 58 have been inoculated once only and show a plague death-rate of 13·79 per cent. (8 altogether): while the remaining 75 who refused inoculation have lost 20 out of their number from plague or a percentage of 23·6. If the twice-inoculated had died in the same proportion as the uninoculated from plague, their total number of deaths would have been 286 instead of 22; and, similarly, the once-inoculated would have had a plague death roll of 16 instead of 8. Every inducement was, however, held out by this public-spirited gentleman to induce his employés to avail themselves of the full benefits of inoculation, which accounts for the numbers of those inoculated once only being so low.

Short sketch of the work done in Hubli.

XXIX.—From the above records it will be seen that, between May 11th and August 23rd, 33,880 inhabitants of Hubli were inoculated. Of this number, 24,138 were inoculated twice and 9,742 once, giving a total number of inoculations performed =58,018 in fifteen weeks, or an average of over 550 inoculations per day! [I have purposely chosen this date in August to close my list, because since then there has been some falling off in the number of inoculations done amongst the actual inhabitants of Hubli, for the simple reason that there were fewer and fewer, as time passed on, to inoculate. On the other hand, the number of people from outside villages who have come into Hubli, seeking inoculation, has very largely increased since the middle of August, some 1,200 having come in for that purpose even previous to that time. None of these "outsiders" have ever been counted amongst our "Hubli inoculations." Their total represents some 5,000 odd, of whom quite half have been inoculated twice; that is to say, an extra total of 7,500 inoculations has been performed in Hubli, but cannot be counted in our returns, as these inoculations were not among actual inhabitants of this town.] Of these 58,000 odd inoculations, the staff on plague duty have done over 37,000, my own numbering 22,000, my Assistant Surgeon's (Mr. Mascarenhas, L.M. & S., Bombay) nearly 12,000; and those of Dr. Winter, who joined us at the beginning of July, some 3,000 odd. Of the remainder Assistant Surgeon Cardoz, in charge of Hubli Dispensary, performed over 17,000; and the three Medical Officers on plague duty for the Southern Mahratta Railway Company, and Dr. Braganza, a practitioner in the town, some 4,000 amongst them.*

This amount of inoculation work in addition to one large hospital (and since August 10th, two) to look after, with an average of over 100 patients, an observation camp of 200 odd persons; a segregation camp of 250; and a Health Camp often containing 700 to 1,000; the enormous amount of clerical work that inoculation entails, and also plague operations generally; the supervision of disinfection and railway inspection; the inspection of cases and granting of all certificates of death in the town; the registers and accounts of all the hospitals and camps (general or private, *i.e.*, caste); the never-ending disputes and complaints that have to be enquired into and settled,—all this will, I trust, afford the impartial observer of the amount of work Dr. Winter and myself, assisted by two Assistant Surgeons (since the end of August, three) and six Hospital Assistants, supplied by Government, with two clerks (of little value) and a compounder supplied by the Hubli Municipality, have had to cope with and actually done.

Short discussion on and comparison between Inoculation and Sanitation with regard to plague in India.

XXX. From an experience of nearly two years on plague duty it may, perhaps, not be out of place if I here state my opinion on the value and position of M. Haffkine's preventative inoculation.

At the outset I would remark that had I been able in Hubli to adopt those sanitary and hygienic measures I wished to adopt, although I certainly should have undertaken inoculation work in addition, I do not think I should have had to do so much of it. But with so few police (and those none too good) to help one, an inadequate British Staff, with so much reliance placed in Native Superintendents and Supervisors, and a Municipality so bankrupt that it could not apparently afford to buy enough blankets out of its own funds for the patients in the Plague Hospitals, the work of segregation, house-to-house inspection, etc., became, from a medical point of view, absurdly insufficient; and despite the fact that strenuous efforts were always made to adopt such sanitary measures as will, I fancy, be regarded as distinctly efficacious, if properly carried out, yet, for want of staff and money (that greatest of all considerations), I was not only willing but actually compelled, by my duty and desire to save life, to undertake preventive measures at first on the scale of the individual, since I was not able to fully adopt them on the larger scale, namely, of the community; and although our inoculation record shows that we have now applied this measure to the community at large by inoculating a whole townful of people (the majority of them twice), yet it must be owned that we have been somewhat fortunate in our experiences here, and that preventative inoculation applied to other places, *e.g.*, other infected towns and districts ***may*** possibly prove to be a somewhat different matter.

While paying the highest tribute to the value of M. Haffkine's inoculation method which I claim, here in Hubli, to have put to, perhaps, the severest test to which it has yet been subjected, I am of the opinion that individual protection is, on however great a scale conducted, of less importance than general protection by sanitation and hygiene (considering each method separately, that is to say), for it seems to me more radical, if not more rational, to eradicate a disease than to leave it to pursue its course and only protect people against its ravages. But I see no reason whatever why the two methods should not be utilized together; and, as there appear to be various difficulties regarding the proper application of sanitary measures, to allow inoculation its fullest scope, I have endeavoured to compare these two methods by contrasting them in tabular form below, and my opinion is that, while neither can, apparently, be carried to perfection, *per se*, in India, both may with the greatest utility be judiciously combined.

CONTRAST AND COMPARISON BETWEEN

Inoculation.	*Sanitary and Hygienic measures.*
(i) Protection of the individual inoculated and later, as inoculation proceeds, of the community. Indirect protection of the uninoculated.	(i) Protection of the community generally (presuming them to be uninoculated) throughout.
(ii) No measures to destroy the bacilli in infected houses, fomites, etc., and in this way check the spread of the disease.	(ii) The bacilli destroyed in infected houses by heat, chemical disinfection, ventilation, etc.
(iii) No measures to remove the sick from the healthy and thus prevent contagion or infection of healthy non-inoculated.	(iii) Removal of the sick and, thus, prevention of areas and persons becoming infected by actual contagion or otherwise.
(iv) No separation of the healthy uninoculated from the sick.	(iv) Separation of the healthy from the sick.
(v) Protection against one particular disease, and possibly against certain others (contagious and infective).	(v) Protection against infective diseases generally.
(vi) Liability of re-infection of house or area, etc., comparatively unimportant (for some months) to the inoculated.	(vi) Liability of re-infection of house, etc., most important (by reason of its danger) to the uninoculated; but capable (though difficult) of prevention.

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* The total number of inoculations performed in Hubli, both on actual inhabitants and on people from outside, *e.g.*, villages, between May 11th and September 27th, amounts to some 78,000 altogether.

It is with no attempt—far less still a wish—to undervalue such brilliant work and so useful to mankind as Haffkine's preventative inoculation against plague undoubtedly is, that I compare the measure with sanitation and general hygiene. Just as Nature's own "disinfectors," sun-light and air (wind), alone appear to prevent outbreaks of various diseases, borne and spread through mal-ventilation, squalor and overcrowding, from occurring in every town or village one visits in India, so it may be suggested that "natural" methods, *e.g.*, ventilation, cleanliness, and freedom of space, combined with such hygienic measures as isolation of the sick and segregation of the healthy, and disinfection (by heat and chemicals)—should be resorted to as a first line of defence and attack with regard to plague, individual protection by inoculation forming a most useful second line. Such, indeed, appears to me an ideal plan of campaign with regard to a disease like plague; but owing to the apparent dislike of the native to real cleanliness and ventilation, and difficulties in getting staff and funds to obtain and maintain efficient segregation and isolation, inoculation must, of necessity, come more prominently to the front.

From a very large experience I am convinced that early notification of cases is the first and most essential factor in dealing with epidemic disease; and I consider it equally important to remove a case of plague early from an overcrowded house (there appear to be few native houses that are not) in order that the other inmates may not acquire contagion should the case assume some grave aspect by which it may spread the disease; as, for instance, when from the lungs of a primary plague pneumonia, myriads of pest bacilli are coughed up by the patient (who invariably dies) and deposited broadcast on the floor and walls of his room, the bedding he lies on, and very largely into the palms of sympathetic friends or relations held out to the sufferer like so many spittoons, whence they are often directly transferred to their clothes and in this way handed round the area, village, or town in which they live; or when the bacilli are passed in greater or lesser hæmorrhages from the alimentary, respiratory, or genito-urinary tracts, in certain fatal forms of plague.

Unfortunately, the average native, educated or not, appears to have the very greatest aversion to notifying any case of sickness—plague or other—and hence, in my opinion, it becomes more necessary than ever to protect the people by inoculation since they will not help to protect themselves by the foremost and simplest of sanitary and hygienic measures.

Short review of criticisms and objections.

XXXI. At various times during my inoculation work in Hubli, different objections against the methods pursued have been raised by friends—and critics generally—, and even in my own mind. I have always investigated the questions as soon as they were offered, and although I have never found one solid objection —after full and minute enquiry—to remain, yet it may be of some advantage to consider their main points here. Before doing so, however, I would again state that given proper notification of disease, sufficient money and staff, competent work-people (*e.g.*, disinfection coolies, etc.), and a population which shows antipathy neither to revelation of cases nor to general sanitary measures, *then* inoculation occupies a very limited position in the prevention of plague. But I have never met with such conditions in India, nor conditions approximating thereto; and hence it appears to me that inoculation arranges itself by the protection it affords in the foremost rank of methods for dealing with this disease.

(*a*) It has been urged that those who received inoculation were of a class or classes better protected than others against plague by reason of their habits, the food they eat, the houses they live in, etc. In reply, I unhesitatingly state that if there be but one town in India, where that line of argument will not hold good, it certainly is Hubli, for not only were the poorer, dirtier, lower caste people the first to be persuaded to receive inoculation, but I made it my personal and special duty to work amongst them. Besides, Hubli is, I believe, the only town not only with such a large number of inoculations done, but also with by far the greatest proportionate number of inoculated to uninoculated in its population and again (I speak guardedly but believe I am correct), it is so far the only town in which inoculation has been largely resorted to at the *beginning* of an epidemic of plague. The Brahmins are, perhaps, of all castes, supposed to be the most cleanly in their houses, habits, etc., yet the Brahmins of Hubli (who at first, imagining themselves immune, were the foremost and greatest perverters of the truth concerning its efficacy and the last to apply for the protection inoculation affords) simply inundated the various inoculation "centres" as soon as plague began to spread in their midst clamouring for the very method of which they had only lately tried to prevent others from availing themselves.

My first few thousand inoculations were almost entirely amongst the lowest and poorest of the people as I have already stated: but even letting that, most important, affirmation pass unheeded, the fact that now practically the whole town (over 95 per cent.) has been inoculated refutes all argument concerning class or caste protection, since the disease attacked all classes and castes and all classes have been inoculated.

(*β*) Another objection raised, and one which presented itself to my mind also, was this:—"Had I, by granting certain concessions allowing inoculated persons to remain in their houses, indirectly caused them to be the means of spreading plague?" Before answering this question, I must draw attention to the fact that not more than about 20 per cent. of plague cases in Hubli have ever been reported as such before death. This, in my opinion, is only what is to be expected when practically the whole work of finding such cases is intrusted to the inhabitants of a native town themselves; but whatever be the cause for this non-report of attacks before death, it must be remembered that the actual plague deaths in Hubli between the inoculated and non-inoculated have averaged 85 per cent. in favour of the former. Supposing, then, that 100 persons die of plague in this town—unreported as cases before death—we find that 85 of them have not, while 15 have been inoculated, or, in other words, there have been nearly six non-inoculated to one inoculated household capable of spreading plague during the times these persons have been sick of the disease. Even allowing that the uninoculated have been segregated, and the inoculated allowed, after disinfection of their kit, person and houses, to remain in their homes, if the uninoculated contacts of such cases be not discovered before these cases die, they are not only quite as liable and capable to spread plague as the inoculated contacts are, but far more likely to do so since their number is nearly six times as great and equally more likely to contract the disease. Further, the removal of the uninoculated to the segregation and other camps, after a *death* from plague has occurred in their midst, is of no greater protection to the rest of the community than leaving inoculated, protected persons, after disinfection of their person and kit, in a disinfected house or area.

A corollary to the above objection was found in the fact that certain non-inoculated, neither actual contacts of plague cases, nor living in contacts' houses, but in the infected area of such cases or deaths, have been sent to the Health Camp, and it was affirmed that these people could not convey infection, though inoculated people might. Now, as a matter of fact, our health camp people were allowed to go into the town, to their homes to work, during the day, and there was absolutely nothing to prevent them visiting friends and relations sick with plague if they wished to. Even supposing that the inoculated might be more likely to become conveyers of plague by remaining in infected areas during the night, it would seem that the houses themselves appear to be the actually infected spots, and, to any one entering them, it will at once become evident that little or no difference can exist between the day and night in such places. Fomites certainly do, in my opinion, play a part in the spread of plague, but to nothing like the extent of contamination or infection of a locality or contagion from person to person in such insanitary places so that I do not agree with the supposition just mentioned, more especially as all possible care was taken, equally with the inoculated as with the uninoculated, over the disinfection of their clothes and kit. Waiving aside other minor and almost absurd considerations which have been suggested by all sorts of people, I feel sure that the inoculated could not (even had they tried) have been the means of spreading the disease to anything like the extent the uninoculated actually did, since the number of attacks and deaths from plague amongst them were 85 per cent. fewer.

(*γ*) It has been alleged that the inoculees may have given false names to those registering them at their first inoculation, in order to eventually obtain a certificate to give or sell others not inoculated: but I hardly think it likely that anyone would undergo the pain and inconvenience of inoculation for such a purpose, or having done so once (for himself) would care to repeat the experiment in order to obtain a certificate (for some one else): further, as by so doing he personally would not benefit by his act (for the certificate—if he gave a false name would be made out for and given to the person answering to that name and description—see paragraph

XVIII), it is difficult to understand why he should do such a thing at all. Nor, for the same reason, would any one be at all likely to exchange the ticket of first inoculation or sell it. Still, granting all these objections, and supposing them to be accurate, such non-inoculated persons on suffering or dying from plague would be counted on our registers as inoculated people who had been attacked by or had died from plague. This would really mean that our results are better than we have recorded them to be, and we know they have averaged—on the whole epidemic—about 85 per cent. in favour of inoculation already.

(δ) Some critics of our work have even suggested that certificates of inoculation may have been obtained by non-inoculated persons through collusion with the inoculators. Having myself inoculated more people in Hubli than anyone else, I hardly consider such criticism courteous, and as I intend my remarks to refer to my staff and the other medical men who had kindly lent their aid, this objection may, I trust, be dismissed without further comment.

(ε) I have frequently been asked how we were able to tell—in the case of unclaimed dead bodies—whether they had been inoculated or not. I have already explained our method of procedure in such instances in paragraph XIX, but would here add that, failing to find any trace or record of inoculation on the corpse, we cannot decide, and would ourselves become enquirers as to how a decision can be arrived at. It must be noted, however, that, taking everything into consideration, not more than 5 per cent. of the total plague deaths have come under this category, and in some of these cases information regarding their having been inoculated has been accepted and recorded by us as actual fact, although we ourselves could arrive at no definite opinion on the subject.

Throughout this epidemic encouragement has been given to everyone to do all he could to show that any person, who had previously been inoculated, had since died of plague; and it is more than probable that very few, if any, such instances escaped the notice of the many persons who disbelieved in inoculation, as the greatest interest and comment is at once excited when any inoculated person contracts plague or dies from it, and the attention of everybody is at once drawn to each such case as if it were (as it really is, though from a different point of view) of the highest importance; for people are very apt to imagine that because inoculation is stated to be protective that, therefore, it must invariably and infallibly be so, and triumphantly publish each case of failure as it occurs. Now, nothing could be more favourable from the inoculator's point of view, for it becomes an easier matter than ever to balance the few failures against the enormous number of successes inoculation is naturally expected as bound to achieve and actually does obtain.

XXXII. I append a list in which the results of protection by inoculation of certain members of a household—the non-inoculated members dying from plague—are shown side by side, for comparison. Each and every instance has been verified within the past three weeks.

XXXIII. I further append three charts—which will also form part of my general report "On Plague Operations in Hubli"—to follow later.

Chart I shows the total death-rate from all causes, the plague attack rate, and Plague death-rate.

Chart II shows, in form of columns, the plague attack and death-rate, amongst the inoculated and uninoculated, the total plague death-rate, and the total admission-rate into the different Plague Hospitals.

Chart III shows, in column form, the attack-rate from plague and the admission-rate into the Plague Hospital.

Chart I is on a daily scale; Charts II and III on a weekly scale.

The asterisk (at the upper part of the page) on Chart II marks the date on which our former restrictions and rules as to the burial of plague corpses were largely cancelled, and I consider that the spread of plague amongst the uninoculated largely followed this event—(our staff being too few to deal with the work in the city at a pace equal with the disease),—but was chiefly due to the non-report of plague cases before death. The total admissions into the hospital (Chart III) were always far below the actual attack-rate; and of these admissions about 15 per cent. were voluntary (towards the end of the epidemic especially), over 50 per cent. were sent up by the two British Officers and four British Inspectors, while ten Native Superintendents and 120 Supervisors managed to send up the remainder.

B. H. F. LEUMANN, M.B., D.Ph.,
Surgeon-Captain, I.M.S.,
in charge Plague Operations, Hubli.

Plague Hospital, Hubli, 1st October 1898.

APPENDIX TO REPORT ON INOCULATION AGAINST PLAGUE IN HUBLI, 1898.

OCCURRENCE OF PLAGUE IN HOUSES INHABITED BY PERSONS INOCULATED AGAINST THE PLAGUE.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 744. Ward No. 3. Division I.	(1) Madarsab Husseinsab, M., 25, 17th May 1898. (2) Imambu Madarsab, F., 26, 21st and 25th June 1898. (3) Sikander Madarsab, 4, 21st and 24th June 1898. (4) Fatima Madarsab, F., 1, 21st and 24th June 1898. (5) Ashabi Mahomedsab, 25, 21st and 24th June 1898.	(1) Mahomedsab Husseinsab, M., 27.
......	(1) Madarsab Husseinsab, M., 25, died of Plague 22nd June 1898.	(1) Mahomedsab Husseinsab, died of Plague on 22nd June 1898.
House No. 717. Ward No. 3. Division No. I.	(1) W. Netto, M., 20, 14th and 17th June 1898. (2) B. Netto, M., 18, 14th and 17th June 1898. (3) Miss K. Netto, F., 14, 14th and 17th June 1898. (4) J. C. Netto, M., 25, 16th and 21st June 1898.	(1) Escolastica Netto, F., 46.
......	......	(1) Died of plague on 24th June 1898.
House No. 745. Division I.	(1) Hallimbo Abdulsab, F., 25, 17th and 23rd June 1898. (2) Kulsuma Allisab, F., 25, 17th and 23rd June 1898. (3) Gorima Badesab, F., 15, 17th and 23rd June 1898. (4) Budansab Imamsab, M., 18, 17th and 28th June 1898. (5) Jainabi Kassimsab, F., 4, 17th and 23rd June 1898.	(1) Imamsab Hassansab, M., 21. (2) Shobuma Hassinsab, F., 10.
....	....	(1) Died of plague on 25th June 1890. (2) Died of plague on 26th June 1898.
House No. 498. Ward No. 2. Division I.	(1) Mohdinsab Pirmahomed, M., 65, 5th and 19th June 1898. (2) Ajibu Mohdinsab, F., 22, 5th and 19th June 1898. (3) Kassimsab Mohdinsab, M., 8, 5th and 10th June 1898 (4) Abraham Mohdinsab, M., 35, 17th and 20th May 1898 (5) Husenbu Hyasab, F., 30, 5th and 19th June 1898. (6) Khatijabu Kassankhan, F., 40, 5th and 19th June 1898. (7) Ismaelsab Mahomedsab, M., 45, 5th and 10th June 1898. (8) Mahabub Kassim, F., 7, 5th and 19th June 1898. (9) Mahomedji Hyatsab, M., 8, 5th and 10th June 1898. (10) Asuma Modhin Chowdry, F., 10, 5th and 10th June 1898. (11) Husensab Umarji, M., 50, 5th and 10th June 1898. (12) Hazratsab Husensab, M., 9, 5th and 19th June 1898. (13) Pir Ahmed Mohdin, M., 28, 4th and 28th June 1898. (14) Mahomed Mohdinsab, M., 25, 5th and 10th June 1898. (15) Hasnama Pirahmed, F., 10, 5th and 19th June 1898. (16) Imambu Hyasab, F., 14, 5th and 19th June 1898. (17) Nanima Husensab, F., 18, 5th and 19th June 1898. (18) Gangawa Mahomedsab, F., 16, 5th and 19th June 1898. (19) Gansusab Ibrahimsab, M., 6, 5th and 10th June 1898. (20) Jorama Ibrahimsab, F., 25, 5th and 19th June 1898.	(1) Ibram Husseinsab, M., 22. (2) Umarsab, M., 15. (3) Fatambi, F., 32. (4) Khadirsab, M., 40. (5) Taj Mahomed, M., 10. (1) Died of plague on 27th June 1898.
House No. 6745. Ward No. 27. Division VI.	(1) Rago Fakirapa, M., 30, 21st and 28th June 1898.	(1) Yemnabai Rajba, F., 27.
......	......	(1) Died of plague on 2nd Jul 1898.
House No. 1488. Ward No. Division II.	(1) Shetewa Fakira, F., 30, 13th and 16th June 1898. (2) Pareshya Fakirapa, M., 25, 13th and 16th June 1898. (3) Fakira Ningapa, M., 50, 13th and 16th June 1898.	(1) Hanimi Shetawa, F., 25.
	...... (3) Fakira Ningapa, died of plague on 21st July 1898.	(1) Died of plague on 4th July 189.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 1369. Ward No. 5. Division I.	(1) Savatriwa Gursidapa, F., 40, 4th and 29th June 1898. (2) Tipanna Gursidapa, M., 27, 18th May 1898 and 2nd June 1898. (3) Gursidapa Tipana, M., 2, 8th and 12th July 1898.	(1) Nagawa Tipanna, F., 30.
......	......	(1) Died of plague on 5th July 1898.
House No. 6495. Ward No. 27. Division VI.	(1) Fakirapa Irbadrapa, M., 36, 27th and 30th June 1898. (2) Gangawa Fakirapa, F., 6, 27th and 30th June 1898. (3) Fakirapa Bassapa, M., 28, 27th and 30th June 1898. (4) Fakirawa Fakirapa, F., 26, 27th June 1898 and 2nd July 1898. (5) Kirtawa Bassapa, F., 45, 27th June 1898 and 2nd July 1898. (6) Shankapa Bassapa, M., 30, 6th and 9th July 1898.	(1) Irawa Fakirapa, F., 31.
......	......	(1) Died of plague on 5th July 1898.
House No. 1240. Ward No. 5. Division I.	(1) Ningapa Balapa, M., 10, no pass (2) Kenchawa Yellapa, F., 50, 20th and 22nd July 1898.	(1) Nagawa Ballapa, F., 35.
......	......	(1) Died of plague on 6th July 1898.
House No. 924. Division I.	(1) Parwati Daji, M., 5th and 13th June 1898 (2) Gungu, F., 7, 5th and 13th June 1898. (3) Sukia, F., 3, 5th and 13th June 1898. (4) Arjun, M., 9, 5th and 13th June 1898. (5) Daji Govind, M., 40, 10th and 13th June 1898. (6) Byabi Gangaram, F., 25, 5th and 10th June 1898. (7) Krishna Gopal, M., 15, 10th and 13th June 1898. (8) Sukoma Govind, F., 25, 5th and 13th June 1898. (9) Gobind Sivaji, M., 38, 10th and 13th June 1898.	(1) Tanubai Maroti, F., 18.
	(10) Mahadev Arjun, M., 30, 10th and 13th June 1898 (11) Mahadev Gunput, M., 25, 7th and 13th June 1898. (12) Kasibai Gunputrao, F., 40, 5th and 10th June 1898. (13) Waman Gunput, M., 20, 5th and 10th June 1898. (14) Kallapa Krishnapa, M., 20, 5th and 10th June 1898. (15) Hari Gopal, M., 18, 6th and 13th June 1898. (16) Bhoma Krishnaji, M., 4, 5th and 13th June 1898. (17) Gowrama Krishnaya, F., 3, 5th and 13th June 1898. (18) Krishnaya Narsaya, M., 28, 17th and 20th July 1898. (19) Pandurang Narsaya, M., 30, 14th June 1898 and 10th July 1898. (20) Junabai Krishnaya, F., 20, 17th and 20th July 1898, (21) Gangaram Balloo, M., 25, 8th and 10th July 1898. (22) Dhunduma Gangaram, F., 2, 11th and 14th July 1898. (23) Rauji Govindapa, M., 25, 8th and 11th July 1898.	(1) Tanubai, died of plague on 10th July 1898.
Miss Omond's Out-houses.	(1) Laximi Mumapa, F., 42, 28th July 1898 and 3rd August 1898. (2) Murjiez Marika, M., 25, 13th and 20th June 1898.	(1) Rangama Murjiez, F., 24.
......	......	(1) Died of plague on 10th July 1898.
House No. 9256. Division VIII. Cowlpet.	(1) Gansusab Nanesab, M., 23, 7th and 26th July 1898	(1) Fatteshabi Nanesab, F., 60.
......	......	(1) Died of plague on 12th July 1898.
Railway Porters' Chawls.	(1) Muniasuamy Narayensuamy, M., 30, 18th June 1898 and 4th July 1898. (2) Munian Narsaya, M., 26, 11th and 15th June 1898. (3) Narayensuamy Narsay, M., 22, 17th and 30th June 1898.	(1) Nagama Narayensuamy, F., 1½.
......	......	(1) Died of plague on 13th July 1898.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 7825. Ward No. 32. Division VII.	(1) Timothy Davali, M., 66, 1st and 11th June 1898 (2) Israel Davali, M., 21, 11th June 1898. (3) Ratna Davali, M., 17, 1st and 11th June 1898. (4) John Ballapa, M., 24, 1st and 11th June 1898. (5) Monesa Dyapa, M., 27, 1st and 11th June 1898, (6) Laximan Timothi, M., 11, 1st and 11th June 1898. (7) Rayava Timothi, F., 15, 1st and 15th June 1898. (8) Mana Davali, F., 49, 1st and 11th June 1898.	(1) Bhaktawa Girepa, 18.
......	......	(1) Ill with plague on 16th July 1898 and died on 17th July 1898.
House No. 6499. Ward No. 27. Division VI.	(1) Vithoba Manapa, M., 40, 7th and 11th July 1898 (2) Sathibai Balkrisna, F., 10, 7th July 1898.	(1) Padaibai Molloji, F., 21. (2) Rama Vithoba, M., 3, 17th July 1898 and 4th August 1898.
......	......	(3) Thakubai Vithoba, F., 34, 17th and 24th July 1898. (4) Bhimabai Vithoba, F., 2, 8th and 17th July 1898.
......	......	(1) Died of plague on 17th July 1898.
House No. 7844, Ward No. 32. Division VII.	(1) Manjinath Vithal, M., 80, 12th and 16th July 1898 . (2) Ningawa Manjinath, F., 65, 11th and 16th July 1898. (3) Mangeshrao Manjinath, M., 42, 14th and 28th June 1898. (5) Krisrao Manjinath, M., 30, 9th and 13th July 1898. (6) Anandrao Mangesh, M., 14, 14th and 28th June 1898. (7) Ganpat Mangesh, M., 12, 28th June 1898 and 9th July 1898. (8) Kalindabai Ramrao, F., 11, 1st and 9th July 1898. (9) Pandurang Ramrao, M., 31, 9th and 16th July 1898. (10) Janti Ramrao, F., 31, 9th and 16th July 1898. (11) Sanju Ramrao, F., 2, 12th and 16th July 1898.	(1) Shivaram Manjinath, M., 22.
......	......	(1) Ill with plague on 16th July 1898 and died on 18th July 1898.
House No. 5776. Ward No. 23. Division V.	(1) Sobanji Krishnaji, M., 50, 26th June 1898 and 3rd July 1898. (2) Jotiba Sobanji, M., 25, 28th June 1898 and 2nd July 1898. (3) Gopal Sobanji, M., 18, 15th and 24th June 1898.	(1) Savubi Sobanji, F., 44.
......	......	(1) Died of plague on 19th July 1898.
House No. 2009. Ward No. 8. Division II.	(1) Parwatiwa Mudkapa, F., 40, 12th and 21st July 1898 (2) Fakirawa Fakirapa, F., 55, 12th and 21st July 1898. (3) Marudrapa Mudkapa, M., 40, 12th and 21st July 1898.	(1) Sowaka Gursidapa, F., 68.
......	......	(1) Died of Plague on 20th July 1898.
House No. 6290. Ward No. 26. Division VI.	(1) Sobana Unkarsa, M., 50, 16th and 23rd June 1898 . (2) Kasibai Subana, F., 30, 16th and 21st June 1898 , (3) Devrarsa Churumansa, M., 6, 9th and 16th July 1898.	(1) Yellubai Churamansa, F., 28. (2) Churamana Subana, M., 35. (3) Ambabai Churamansa, F., 24th and 27th July 1898.
......	......	(4) Imnasa Churanmansa, M., 5, 24th and 27th July 1898.
......	......	(5) Tuljapa Churamansa, M., 3, 24th and 27th July 1898.
......	......	(1) Died of plague on 21st July 1898.
House No. 5021. Ward No. 21. Division V.	(1) Gurapa Irbasapa, M., 10, 24th June 1898 and 4th July 1898. (2) Gangapa Irbasapa, M., 12, 24th June 1898 and 4th July 1898. (3) Baswaneva Irbasapa, F., 24, 16th June 1898 and 4th July 1898. (4) Nilawn Mahnidrapa, F., 16, 4th and 11th July 1898. (5) Mahindrapa Gursidapa, M., 34, 21st June 1898 and 8th July 1898.	(1) Advieja Irbasapa, F., 40. (2) Hachapa Irbassa, M., 22, 25th July 1898 and 4th August 1898.
	......	(1) Died of plague on 21st July 1898.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 7180. Ward No. 28. Division VI.	(1) Bhimasa Dongarsa, M., 25, 27th June 1898 and 3rd July 1898. (2) Ishwarsa Dongarsa, M., 40, 22nd and 30th June 1898 . (3) Morarsa Dangarsa, M., 24, 23rd June 1898 and 2nd July 1898. (4) Inkosa Dongarsa, M., 16, 23rd June 1898 and 2nd July 1898. (5) Yunnasa Ishwarsa, M., 13, 22nd and 27th June 1898. (6) Subasa Ishwarsa, M., 12, 20th and 27th June 1898 . (7) Tikosa Ishwarsa, M., 10, 23rd and 27th June 1898 . (8) Santikosa Ishwarsa, M., 69, 17th and 22nd July 1898. (9) Dongarsa Ishwarsa, M., 4, 10th and 21st July 1898. (10) C. Kundabai Ishwarsa, F., 35, 10th and 21st July 1898.	(1) Chandusa Ishwarsa, M., 2, 21st and 24th July 1898. (2) Yellapa Morarsa, M., 2, 21st and 27th July 1898. (3) Gantubai Dongarsa, F., 45, 22nd and 24th July 1898. (4) Ambati Moraisa, F., 18, 21st and 23rd July 1898. (5) Ithubai Kristapa, F., 25. (6) Kristapa Bhimasa, M., 32.
......	......	(6) Died of plague on 21st July 1898.
House No. 6184. Ward No. 25 (C.). Division V.	(1) Radhabai Irapa, F., 40, 23rd and 27th July 1898 . (2) Manava Bhimapa, F., 8, 17th and 31st July 1898. (3) Manapa Bhimapa, M., 5, 17th and 31st July 1898.	(1) Laximawa Bhimapa, F., 30.
......	......	(1) Died of plague on 21st July 1898.
House No. 5499. Ward No. 22. Division V.	(1) Suami Gopalrao, M., 30, 6th and 27th June 1898 . (2) Ramchandra Gopal, M., 25, 5th and 17th July 1898 . (3) Dhondu Gopal, M., 18, 4th and 13th July 1898. (4) Savitri Suamirao, F., 25, 4th and 17th July 1898. (5) Krishnabai Gopalrao, F., 14, 4th and 17th July 1898. (6) Ramchandra Bhagwant, M., 20, 5th and 17th July 1898.	(1) Laximi Suamirao, F., 18. (2) Sitabai Ramchandra, F., 12.
......	......	(2) Died of plague on 23rd July 1898.
House No. 7193. Ward No. 28. Division VI.	(1) Onawa Parsapa, F., 40, 25th June 1898 and 6th July 1898. (2) Kalawa Khemapa, F., 42, 25th June 1898 and 6th July 1898.	(1) Jinapa Khemapa, M., 13.
......	......	(1) Died of plague on 23rd July 1898.
House No. 5260. Ward No. 22. Division V.	(1) Binda Balanaik, M., 14, 10th and 16th July 1898 . (2) Chitamber Balanaik, M., 22, 10th and 16th July 1898. (3) Balaji Balanaik, M., 42, 10th and 16th July 1898.	(1) Chandrubai Balanaik, F., 35.
......	......	(1) Died of plague on 24th July 1898.
House No. 6103. Ward No. 25 (b). Division V.	(1) Bhimabai Narhar, F., 39, 30th July 1898 and 4th August 1898. (2) Krishnaji Narhar, M., 14, 16th July 1898 and 1st August 1898. (3) Narhar Waman, M., 40, 30th July 1898 and 19th July 1898. (4) Datu Waman, M., 30, 10th and 19th July 1898.	(1) Yeswant Narhar, M., 5.
......	......	(1) Died of plague on 25th July 1898.
House No. 1163. Ward No. 5. Division I.	(1) Ishwarsa Tanosa, M., 5, 5th and 16th July 1898. (2) Mahadusa Tanosa, M., 10, 16th and 29th June 1898. (3) Sawatribai Tanosa, F., 30, 9th and 15th June 1898. (4) Yellapa Tanosa, M., 20, 23rd May 1898 and 16th June 1898.	
......	(4) Died of plague on 25th July 1898.	

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 9004. Ward No. 39. Division VIII.	(1) Adviepa Sangapa, M., 60, 6th and 19th July 1898. (2) Irawa Mallapa, F., 5th August 1898.	(1) Mallapa Adviepa, M., 30.
......	......	(1) Died of plague on 26th July 1898.
House No. 1177. Ward No. 5. Division I.	(1) Ibrahim Rustum, M., 40, 4th and 22nd June 1898. (2) Imamsab Ibramsab, M., 25, 4th and 22nd June 1898. (3) Abdul Kadir Ibramsab, M., 12, 26th June and 4th July 1898. (4) Miambi Ibramsab, F., 50, 11th and 21st July 1898. (5) Ashabi Ibramsab, F., 15, 28th June 1898 and 3rd July 1898. (6) Hafizbi Husseinsab, F., 14, 28th June 1898 and 3rd July 1898. (7) Badibi Abdulsab, F., 22, 11th and 22nd June 1898. (8) Sarambi Abdul Kadar, F., 6, 11th and 22nd June 1898. (9) Rustamsab Ibramsab, M., 6, 4th and 22nd June 1898.	
......	(9) Died of plague on 26th July 1898.	
House No. 2175. Ward No. 9. Division II.	(1) Imambi Davalsab, F., 18, 3rd and 22nd July 1898 (2) Davalsab Gudusab, M., 20, 4th and 26th June 1898.	(1) Manabu Husensab, F., 43.
......	......	(1) Died of plague on 26th July 1898.
House No. 6523. Ward No. 27. Division VI.	(1) Gursidawa Chennapa, F., 70, 22nd and 27th June 1898.	(1) Chennapa parvatapa.
......	(1) Ill with plague on 27th July 1898 and discharged cured on 22nd August 1898.	(1) Died of plague on 27th July 1898.
House No. 6630. Ward No. 27. Division VI.	(1) Adviepa Murtenapa, M., 40, 7th and 13th July 1898 (2) Gadgiepa Huchapa, M., 12, 7th and 13th July 1898. (3) Gursidawa Huchapa, F., 40, 7th and 13th July 1898. (4) Sidawa Huchapa, F., 8, 7th and 13th July 1898. (5) Adiviewa Rudrapa, F., 14, 7th and 13th July 1898. (6) Gangawa Adviepa, F., 16, 7th and 13th July 1898. (7) Rudrapa Satapa, M., 25, 7th and 13th July 1898. (8) Huchya Malawa, M., 38, 10th and 19th August 1898. (9) Mallaya Huchya, M., 18, 3rd and 15th August 1898.	(1) Satapa Chenbasapa, M., 60.
......	......	(1) Died of plague on 27th July 1898.
House No. 5347. Ward No. 22 (B.). Division V.	(1) Bassapa Ningapa, M., 25, 8th and 19th July 1898 (2) Bassapa Gursidapa, M., 32, 19th and 28th July 1898.	(1) Fakirapa Ningapa, M., 31.
......	......	(1) Died of plague on 27th July 1898.
House No. 6522. Ward No. 27. Division VI.	(1) Sukerawa Mallapa, F., 50, 19th and 26th July 1898.	(1) Ningapa Mallapa, M.
......	......	(1) Ill with plague on 27th July 1898 and discharged cured on 9th August 1898.
House No. 5347. Ward No. 22. Division V.	(1) Bassapa Gursidapa, M., 35, 19th and 28th July 1898 (2) Bassapa Ningapa, M., 25, 8th and 19th July 1898.	(1) Ningapa Shivapa, M., 64. (2) Fakirapa Ningapa, M., 30.
......	......	(1) Died of plague on 13th August 1898.
......	......	(2) Died of plague on 27th July 1898.
House No. 2784. Ward No. 12. Division III.	(1) Maktumsab Janglisab, M., 35, 17th May 1898 (2) Abdulrahim Muktumsab, M., 6, 17th May 1898.	(1) Ratma Janglisab, F., 65.
......	......	(1) Died of plague on 28th July 1898.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 1589. Ward No. 6. Division II.	(1) Renasa Subramansa, M., 30, 23rd May 1898 and 26th June 1898. (2) Subramansa Renasa, M., 12, 23rd May 1898 and 26th June 1898. (3) Ganpatsa Renasa, M., 8, 23rd May 1898 and 26th June 1898.	(1) Rakmabai Renasa, F., 28.
......	......	(1) Died of plague on 28th July 1898.
House No. 1723. Ward No. 7. Division II.	(1) Karbasapa Chenbasapa, M., 55, 3rd and 16th August 1898. (2) Baslingawa Karbasapa, F., 4, 16th and 20th July 1898. (3) Gursidapa Karbasapa, M., 23, 16th and 19th July 1898. (4) Baslingapa Karbasapa, M., 17, 13th and 30th June 1898. (5) Nagawa Gursaidapa, F., 22, 16th and 21st July 1898. (6) Nalawa Karbasapa, F., 30, 16th and 19th July 1898.	(1) Chenbasapa Karbasapa, M., 24.
......	......	(1) Died of plague on 29th July 1898.
House No. 5434. Division V.	(1) Irawa Malleshapa, F., 20, 4th and 27th July 1898 . (2) Bhagawa Virpakshapa, F., 45, 19th June 1898 and 4th July 1898. (3) Irapa Virpakshapa, M., 41, 27th and 30th July 1898. (4) Kristawa Ramapa, F., 20, 27th July 1898 and 4th August 1898.	(1) Ramapa Virpakshapa, M., 25.
......	......	(1) Died of plague on 30th July 1898.
House No. 5473. Ward No. 22. Division V.	(1) Ramapa Manaji, M., 6, 26th June 1898 and 3rd July 1898. (2) Nagendra Manaji, M., 9, 26th June 1898 and 3rd July 1898. (3) Chandrabai Manaji, F., 20, 16th and 24th July 1898. (4) Yellubai Manaji, F., 6, 16th and 19th July 1898. (5) Manaji Yellapa, M., 30, 26th June 1898 and 23rd July 1898. (6) Girjabai Parasram, F., 35, 6th and 16th July 1898. (7) Sawubai Rajba, F., 18, not present, but inoculated twice.	(1) Parasram Yellapa, M., 35.
......	......	(1) Died of plague on 30th July 1898.
House No. 7770. Ward No. 31. Division VII.	(1) Rachawa Krishnasa, F., 40, 22nd June 1898 and 1st July 1898. (2) Dekubai Yellapa, F., 20, 22nd June 1898 and 1st July 1898. (3) Dongrubai Dhondasa, F., 22, 8th and 16th July 1898. (4) Santubai Parasram, F., 40, 22nd June 1898 and 1st July 1898. (5) Vithaba Bankopa, M., 24, 22nd June 1898 and 1st July 1898. (6) Ishwarbai Vithoba, F., 14, 22nd June 1898 and 1st July 1898. (7) Laxmibai Malkapa, F., 20, 22nd June 1898 and 1st July 1898. (8) Dhondusa Ambasa, M., 28, 22nd June 1898 and 1st July 1898.	(1) Ambubai Malkapa, F., 1½ (20th and 24th August 1898).* (2) Ambabai Dhondusa, F., 8. (2) Yellubai Ambasa, F., 40 (12th and 15th August 1898).* (4) Malkapa Bankapa, M., 22 (11th and 20th August 1898).* (5) Malkapa Ambasa, M., 34. (6) Yellapa Tuljapa, M., 30.
......	......	(2) Died of plague on 31st July 1898.
......	(5) Ill with plague on 3rd August 1898 and discharged cured on 11th August 1898.	(5) Ill with plague on 8th August 1898 and died on 11th August 1898.
......	(6) Ill with plague on 3rd August 1898 and discharged cured on 13th August 1898.	(6) Ill with plague on 3rd August 1898 and discharged cured on 13th August 1898.

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* These received inoculation after the death of the first Plague case amongst them, uninoculated at that time.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the date of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House Nos. 2774 and 75. Ward No. 12. Division III.	(1) Nanima Dostgirsab, F., 10, 17th May 1898 and 5th June 1898. (2) Dostgirsab Hajratsab, M., 40, 17th May 1898 and 5th June 1898. (3) Abdulkadir Hazratsab, M., 35, 17th May 1898 and 5th June 1898. (4) Hapuna Hajratsab, F., 60, 17th May 1898 and 5th June 1898.	(1) Dostgirsab Barasab, M., 75.
	......	(1) Died of plague on 31st July 1898.
House Nos. 4439 and 40. Ward No. 19. Division .	(1) Yellapa Jattapa, M., 60, 5th and 8th June 1898 . (2) Baiwa Yellapa, F., 40, 5th and 8th June 1898.	(1) Hallawa Yellapa, F., 11. (2) Bhomawa Yellapa, F., 14.
......	......	(1) Died of plague on 31st July 1898.
......	......	(2) Ill with plague on 31st July 1898 and died on 6th August 1898.
House No . Ward No. . Division . Now living in House No. 6458. Ward No. 27. Division VI.	(1) Parvatibai Ganpatsa, F., 14, 25th July 1898 and 17th August 1898. (2) Govindsa Sabasa, 16, 23rd and 25th July 1898. (3) Krishtapa Nagosa, 3 months, 13th and 20th August 1898. (4) Dikapa Tuljapa, M., 8, 23rd and 27th July 1898. (5) Nemasa Nersingsa, M., 26, 2nd and 10th August 1898. (6) Kushapa Tuljapa, M., 10, 23rd and 27th July 1898. (7) Ramchandra Narsingsa, M., 10, 23rd and 27th July 1898. (8) Deorarsa Tuljapa, M., 6, 23rd and 27th July 1898. (9) Krishnasa Tuljapa, M., 16, 23rd and 27th July 1898. (10) Laxmibai Nagosa, F., 18, 13th and 20th August 1898. (11) Bhagubai Vegosa, F., 2, 25th July 1898 and 17th August 1898. (12) Gunpatsa Subasa, M., 18, 23rd and 27th July 1898. (13) Nagosa Subasa, M., 22, 23rd and 27th July 1898. (14) Yegusa Narsingsa, M., 25, 23rd and 27th July 1898.	(1) Mahdusa Nemasa, M., 2. (2) Nagubai Tuljapa, F., 2. (3) Parasram Narsaspa, M., 30. (4) Yellubai Nemasa, F., 24. (5) Tukaram Narsapa, M., 18. (6) Godavari Nemasa, M., 2. (7) Yedusa, M., 5.
......	......	(1) Died of plague on 1st August 1898.
......	......	(2) Died of plague on 1st August 1898.
......	......	(3) Ill with plague on 5th August 1898 and died on 8th August 1898.
......	......	(4) Ill with plague on 5th August 1898 and died on 10th August 1898.
......	......	(6) Died of plague on 3rd August 1898.
House No. 5863. Ward No. 24. Division V.	(1) Rajesab Imamsab, M., 7th and 13th June 1898 . (2) Nanesab Alisab, M., 35, 27th June 1898 and 2nd July 1898.	(1) Ashabi Nanesab, F., 30. (2) Mohdinbi Nanesab, F., 5.
	......	(1) Died of plague on 2nd August 1898.
	......	(2) Died of plague on 10th August 1898.
House No. 2005. Ward No. 8A. Division II.	(1) Fakirawa Mallapa, F., 13, 12th and 26th July 1898 . (2) Mallapa Gursidapa, M., 46, 12th July 1898 and 4th August 1898. (3) Rachapa Mallapa, M., 12, 12th July 1898 and 4th August 1898. (4) Jrawapa Mallapa, F., 7, 12th July 1898 and 26th July 1898.	(1) Gurisdapa Parapa, M., 35.
......	... ..	(1) Died of plague on 3rd August 1898.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 5280. Ward No. 22A. Division V.	(1) Fakirsa Khandusa, M., 40, 16th and 23rd July 1898 .	(1) Yellubai Parasram, F., 20.
	(2) Fikarsa Fakirsa, M., 22, 8th and 23rd July 1898 .	
	(3) Khandusa Fakirsa, M., 16th and 19th July 1898.	
......	......	(1) Died of plague on 3rd August 1898.
House No. 5856. Ward No. 24B. Division V.	(1) Ragesab Rajesab, M., 21	(1) Pirsab Rajesab, M., 12.
	(2) Kassimsab Rajaksab, M., 3, 4th and 20th August 1898.	(2) Kassimsab Rajesab, M., 8.
	(3) Hajratsab Rajaksab, M., 15, 26th June 1898 and 1st July 1898.	(3) Pirnia Rajaksab, F., 1.
......	......	(4) Imambu Rajaksab, F., 40.
......	......	(5) Kulsumbi Rajaksab, F., 22.
......	......	(1) Died of plague on 5th August 1898.
......	......	(2) Died of plague on 17th August 1898.
......	......	(3) Died of plague on 16th August 1898.
House No. 5846. Ward No. 24. Division V.	(1) Kassimsab Mahomed, M., 25, 28th June 1898 and 2nd July 1898.	(1) Mohdinbi Alisab, F., 48.
	(2) Mahomed Alisab, M., 53, not present, but inoculated twice.	(1) Died of plague on 6th August 1898.
	......	
House No. 5822. Ward No. 24 A. Division V.	(1) Abdulkadir Fakrudin, M., 23, 18th June 1898 and 1st July 1898.	(1) Abulrahiman Fakrudin, M., 35.
	(2) Muktum Hussein Fakrudin, M., 14, 26th June 1898 and 1st July 1898.	
	(3) Dorabi Muktum, F., 11, 19th and 24th July 1898.	
	(4) Jamalbi Abdul Fakrudin, F., 5, not present, but inoculated twice.	
......	......	(1) Died of plague on 7th August 1898.
House No. 7761. Ward No. 31. Division VII.	(1) Ishwarsa Gangasa, M., 16, 22nd June 1898 and 16th July 1898.	(1) Laxmibai Rajansa, F., 25.
	(2) Jambubai Gangasa, F., 10, 22nd June 1898 and 1st July 1898.	(2) Rajansa Gangusa, M., 26.
	(3) Gangasa Ranuasa, M., 48, 22nd June 1898 and 16th July 1898.	(3) Tuljubai Gangasa, F., 1½.
......	......	(1) Ill with plague on 5th August 1898 and discharged cured on 15th August 1898.
......	......	(2) Ill with plague on 9th August 1898 and died on 9th August 1898.
......	......	(3) Died of plague on 7th August 1898.
House No. 5445. Ward No. 22 (C.). Division V.	(1) Vittoba Ramapa, M., 22, 18th and 24th July 1898 .	(1) Ranawa Ballapa, F., 25.
	(2) Balkrishna Venkapa, M., 30, 7th and 10th July 1898 .	(2) Shriniwas Ballapa, M., 6 months.
	(3) Ramapa Nagoji, M., 55, not present, but inoculated twice.	
......	......	(1) Died of plague on 8th August 1898.
......	......	(2) Died of Bronchitis on 4th August 1898.
House No. 5882. Ward No. 24 (B.). Division V.	(1) Rajabu Abasab, F., 11, 2nd and 8th July 1898 . .	(1) Maktumbi Abasab, F., 2.
	(2) Pirsal Abasab, M., 9, 1st and 8th July 1898 . .	(2) Imambu Abasab, F., 35.
......	......	(3) Malangsab Kasimsab, M., 70.
......	......	(4) Perma Mohdinsab, F., 14.
......	......	(5) Abasab Mallangsab, M., 48.
......	......	(5) Died of plague on 10th August 1898.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated ;* date of onset of disease, symptoms, issue.	Names, sexes and age of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated ;* date of onset of disease, symptoms, issue.
House No. 5844. Ward No. 24 (A.). Division V.	(1) Hazratsab Hassansab, M., 50, 25th June 1898 and 1st July 1898. (2) Allabakshah Hazratsab, M., 1, 2nd and 9th July 1898. (3) Khatijabi Hazratsab, F., 30, 2nd and 9th July 1898.	(1) Khajama Hazratsab, F., 4.
......	......	(2) Died of plague on 10th August 1898.
House No. 1657. Ward No. 6 (B.). Division II.	(1) Sidlingapa Gupara, M., 26, 7th and 14th July 1898. (2) Satawa Shidlingapa, F., 4, 28th July 1898 and 3rd August 1898.	(1) Gurpadapa Gurapa, M., 54. (2) Mursavirapa Gurpadapa, M., 25.
......	......	(1) Died of plague on 11th August 1898.
House No. 5308. Ward No. 22. Division V.	(1) Somana Santapa, M., 25, 7th and 11th June 1898	(1) Hanmantapa Santapa, M., 40.
......	......	(1) Died of plague on 10th August 1898.
House No. 5861. Ward No. 24 (B.). Division V.	(1) Rajesab Imamsab, M., 50, 7th and 13th June 1898	(1) Mohdinbi Nanesab, F., 5.
	......	(2) Jansabi Rajesab, F., 38.
......	......	(1) Died of plague on 10th August 1898.
......	......	(2) Died of plague on 25th August 1898.
House No. 4876 & 79. Ward No. 21. Division V.	(1) Nagapa Shivapa, M., 28, 19th July 1898 and 7th August 1898.	(1) Murigepa Shivapa, M., 34.
	(2). Virapa Shivapa, M., 14, 31st July 1898 and 13th August 1898.	(2) Shivapa Nagapa, M., 72.
	(3) Gangawa Murigepa, F., 12, 31st July 1898 and 13th August 1898.	(3) Salaiva Murigepa, F., 4.
	(4) Savantrewa Murigepa, F., 6, 31st July 1898 and 13th August 1898.	(4) Rachawa Murigepa, F., 30.
......	......	(5) Gurlingawa Shivapa, F., 50.
......	......	(6) Nagawa Murigepa, F., 10 (31st August and 7th September 1898.*)
......	......	(2) Died of plague on 13th August 1898.
......	(4) Ill with plague on 18th August 1898 and discharged cured on 15th September 1898.	(3) Died of plague on 11th August 1898.
House No. 375. Ward No. 215. Division I.	(1) Virapa Chenapa, M., 25, 26th July 1898 and 1st August 1898. (2) Bassapa Yellapa, M., 14, 31st January 1898 and 14th February 1898. (3) Chinawa Sidlingapa, F., 33, 31st January 1898 and 14th February 1898. (4) Kasibai Sidlingapa, F., 25, 10th and 15th June 1898. (5) Basawa Kalapa, F., 15, 21st and 28th July 1898. (6) Sanmukhapa Sidapa, M., 22, 31st January 1898 and 14th February 1898. (7) Laxmawa Sidapa, F., 36, 31st January 1898 and 14th February 1898. (8) Siddapa Hullgapa, M., 40, 14th February 1898	(1) Irapa Chenbasa, M., 13.
......	......	(1) Died of plague on 12th August 1898.

* Inoculated after (2) and (3) had died of plague, uninoculated at time of their deaths.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 5105. Ward No. 21. Division V.	(1) Parvatiwa Sangapa, F., 8, 26th and 30th September 1898. (2) Shirsawa Bassapa, F., 30, 4th and 29th August 1898. (3) Parvatiwa Sangapa, F., 8, 26th and 30th September 1898. (4) Hanmant Mahrudrapa, M., 26, 27th July 1898 and 3rd August 1898. (5) Parawa Ramchandra, F., 25, 11th and 23rd July 1898. (6) Kalapa Mahrudrapa, M., 20, 24th and 30th July 1898. (7) Savantrewa Sangapa, F., 6, 26th and 30th July 1898. (8) Tangawa Mahrudrapa, F., 50, 16th and 29th August 1898. (9) Venkawa Kalapa, F., 18, 3rd and 23rd August 1898. (10) Basawant Bassapa, M., 7, 4th and 23rd August 1898. (11) Bassapa Balla, M., 50, 4th and 23rd August 1898.	(1) Adviepa Ramapa, M., 45. (2) Manawa Adviepa, F., 25. (3) Somana Hanmant, M., 1½ month. (4) Bhagawa Shirsapa, F., 50 (13th and 28th August 1898).* (5) Jevubai Adviepa, F., 8 (13th and 28th August 1898).* (6) Bhimawa Adviepa, F., 5 (13th and 28th June 1898).* (7) Sundrawa Adviepa, F., 4. (8) Kallapa Bassapa, M., 65. (9) Bassapa Kallapa, M., 35. (10) Sangapa Kalapa, M., 30. (11) Somapa Bassapa, M., 13. (12) Shivapa Bassapa, M., 6. (13) Virupanapa Bassapa, M., 1. (14) Naisawa Subanna, F., 40. (15) Rachawa Kalapa, F., 25. (16) Gangawa Sangapa, F., 10. (17) Sitawa Kallapa, F., 6. (18) Jaikalrwa Sangapa, F., 18. (19) Virapa Kalapa, M., 50. (20) Virbada Virapa, M., 8. (21) Kalawa Hanmans. (1) Ill with plague on 20th August 1898 and died on 24th August 1898. (2) Died of plague on 15th August 1898. (3) Died of plague on 13th August 1898.
House No. 5276. Ward No. 22 (A). Division V.	(1) Fakirsa Yellapa, M., 42, 19th and 27th September 1898. (2) Nemasa Yellapa, M., 6, 24th July 1898 and 2nd August 1898. (3) Sanmuksa Fakirsa, M., 8, 22nd and 27th September 1898. (4) Tuljabai Fakirsa, F., 35, 24th July 1898 and 2nd August 1898.	(1) Dasim Fakirsa, M., 20. (2) Ningubai Fakirsa, F., 3 (25th and 29th August 1898).†
......	......	(1) Died of plague on 14th August 1898.
House No. 5057. Ward No. 21 (B). Division V.	(1) Gangawa Shivlingapa, F., 60, 6th and 19th June 1898. (2) Fakirawa Genapa, F., 12, 6th and 19th June 1898. (3) Irawa Sangapa, F., 10, 6th and 19th June 1898. (4) Bassawa Sangapa, F., 20, 19th June 1898 and 4th July 1898. (5) Huchawa Virupax, F., 7, 6th and 19th June 1898. (6) Sangapa Shivapa, M., 25, 19th June 1898. (1) Ill with plague on 14th August 1898 and discharged cured on 28th August 1898. (2) Ill with plague on 14th August 1898 and discharged cured on 30th August 1898.	(1) Fakirapa Gurshidapa, M., 6. (2) Irapa Shivapa, M., 40. (3) Gurshidawa Chenviropa, F., 30. (4) Shidlingapa Chenvirappa, M., 2. (3) and (4) died of plague on 14th August 1898.
Health Camp.	(1) Ramchandra Govind, M., 30, 5th August 1898. (2) Krishna Ramchandra, M., 3, 5th and 16th August 1898. (3) Chandri Ramchandra, F., 5, 5th and 16th August 1898. (4) Laximan Govind, M., 25, 29th June 1898 and 16th August 1898. (5) Nithu Ramchandra, M., 8, 5th and 16th August 1898. (1) Ill with plague on 20th August 1898 and discharged cured on 31st August 1898.	

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* Inoculated after (3) had died of plague, uninoculated at that time.

† Inoculated after the death, from plague, of (1).

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated;* date of onset of disease, symptoms, issue.	Names, sexes, and ages of the *uninoculated* persons who were living in the same house on tha date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated;* date of onset of disease, symptoms, issue.
House No. 416. Ward No. 2. Division I.	(1) Adviepa Nurandapa, F., 35, 2nd and 10th June 1898. (2) Rachawa Nurandapa, F., 3, 2nd and 10th June 1898. (3) Ulnapa Nurandapa, M., 9, 2nd and 10th June 1898. (4) Mallawa Bassapa, F., 12, 4th and 18th August 1898. (5) Gangawa Chanbasapa, F., 60, 4th and 18th August 1898. (6) Gangapa Bhimapa, M., 7th June 1898 and 17th July 1898. (7) Rajawa Bhimapa, F., 26th June 1898 and 17th July 1898.	(1) Bhimapa Gangapa, M., 40
......	......	(1) Died of plague on 4th Septrmber 1898.
House No. 9641. Ward No. 42. Division IX.	(1) Biama Samaji, F., 40, 15th and 26th August 1898. (2) Imambu Badimia, F., 4, 15th and 26th August 1898.	(1) Burasab Badesab, M., 34.
......	......	(1) Died of plague on 16th Septamber 1898.
House No. 10776. Ward No. 47. Division X.	(1) Rachapa Madvialapa, M., 36, 22nd July 1898 and 7th August 1898. (2) Baswanewa Rachapa, F., 8, 30th July 1898 and 24th August 1898. (3) Shadavari Bassapa, M., 11, 5th and 18th July 1898. (4) Rachawa Bassapa, F., 50, not present.	(1) Bassapa Shivapa, M., 45. (2) Sangowa Kombassapa, F., 30.
......	......	(1) Ill with plague on 10th September 1898. (2) Died of plague on 10th September 1898.
House No. 10960. Ward No. 47. Division X.	(1) Bassapa Shivapa, M., 25, 24th August 1898 and 2nd September 1898. (2) Mallapa Baslingapa, M., 12, 24th August 1898 and 2nd September 1898. (3) Adviawa Baslingapa, F., 8, 15th August 1898 and 5th September 1898. (4) Basawa Shivapa, F., 50, 15th August 1898 and 6th September 1898. (5) Baslingawa Baslingapa, F., 40, 15th August 1898 and 5th September 1898.	(1) Baslingapa Shivapa, M. 40.
	......	(1) Died of plague on 15th September 1898.
House No. 4543. Ward No. 20. Division IV.	(1) Baswanapa Shidapa, M., 28, 27th July 1898 and 4th August 1898. (2) Gangawa Shidapa, F., 50, 5th and 12th August 1898. (3) Shankerawa Virbadrapa, F., 22, 24th July 1898 and 3rd August 1898. (4) Parwatewa Virbasapa, F., 30, 27th July 1898 and 7th August 1898. (5) Shivlingapa Shidapa, M., 22, 27th July 1898 and 7th August 1898. (6) Virapa Virbasapa, M., 10, 23rd July 1898 and 3rd August 1898. (7) Virbasawa Virbudrapa, F., 5, 21st July 1898 and 3rd August 1898. (8) Rachawa Virbasapa, F., 5, 23rd July 1898 and 3rd August 1898.	(1) Siddapa Virbadrapa, M., months.
	......	(1) Died of plague on 16ht September 1898.

Full Address.	Names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if he is amongst the *inoculated*; date of onset of disease, symptoms, issue.	Names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if he is amongst the *uninoculated*; date of onset of disease, symptoms, issue.
House No. 9409. Ward No. 41. Division IX.	(1) Fakira Tipanna, M., 14, 22nd July 1898 and 17th August 1898. (2) Tukapa Takapa, 22, 22nd July 1898 and 16th August 1898. (3) Yeshwant Tipanna, M., 11, 22nd July 1898 and 17th August 1898. (4) Dawalapa Hanmantapa, M., 22, 22nd July 1898 and 17th August 1898. (5) Mohdia Gangapa, M., 4, 22nd July 1898 and 17th August 1898. (6) Chimnibai Gangapa, F., 24, 17th and 27th June 1898. (7) Umiga Krishnajapa, M., 12, 22nd July 1898 and 21st August 1898. (8) Chandrawa Krishnajapa, F., 40, 22nd July 1898 and 16th August 1898. (9) Owawa Dharmapa, F., 14, not present.	(1) Laxmiawa Tipanna, F., 8.
	......	(1) Died of plague on 16th September 1898.
House No. 11480. Ward No. 43. Division X.	(1) Isamohdin Mordansab, M., 25, 3rd and 13th August 1898. (2) Kalsumbi Hassansab, F., 60, 29th August 1898 and 9th September 1898. (3) Ashubi Mardansab, F., 50, 29th August 1898 and 9th September 1898. (4) Hajratbi Isamohdinsab, F., 20, 29th August 1898 and 9th September 1898. (5) Vahabsab Hassansab, M., 40, not present. (6) Hassansab Hussensab, M., 60, not present. (7) Abdulkarim Mardansab, M., 12, not present . .	(1) Mahomed Hussein, M., 2. (2) Jorabi Vahabsab, F., 36. (2) Died of plague on 17th September 1898.

APPENDIX No. XVI.

NOTES ON CASES OF PLAGUE IN INOCULATED PERSONS BY DR. HORNABROOK.

Cases of Plague in the Dharwar Plague Hospital in inoculated persons.

Number.	Name.	Age.	Sex.	Date of inoculation.	Doctor who inoculated.	Number of days between inoculation and attack.	Attack.	Admission.	Discharge.	Death.	Situation of bubo.	Days in hospital.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Deviden Gunesh . . .	17 yrs.	M.	15-8-98 (No. 15)	Dr. Davidson	16	31-8-98	2-9-98	14-9-98	...	right groin.	12 days	T. 102·8° on admission.
2	Susedera Sublapati . .	7 „	F.	16-9-98 (No. 1315)	„ „	3	19-9-98	22-9-98	30-9-98	...	left „	8 „	T. 103° highest.
3	Anant Gopal	15 „	M.	1-9-98 (No. 518)	„ „	17	18-9-98	23-9-98	1-10-98	...	right „	8 „	T. 103·2° highest.
4	Venkatachalam Thengobola .	19 „	M.	12-9-98 (No. 1095)	„ „	10	22-9-98	23-9-98	27-9-98	...	left „	4 „	T. 99·8° „
5	Mahadin Vasudew Reye . .	8 „	M.	2-9-98 (No. 629)	„ „	25	27-9-98	30-9-98	9-10-98	...	„ „	10 „	T. 104·2° on admission.
6	Gurunath Balaji Kulkarni .	24 „	M.	19-9-98 (No. 1654)	„ „	9	28-9-98	30-9-98	6-10-98	...	right „	7 „	T. 103° „
7	Chumbasappa Kadappa . .	2 „	M.	28-9-98 (No. 2452)	„ Corthorn	1	29-9-98	4-10-98	11-10-98	...	left „	8 „	T. 103° „
8	Jaidan Appavoo . . .	15 „	M.	9-9-98 (No.)	„ Davidson.	24	3-10-98	4-10-98	9-10-98	...	right „	5 „	T. 100° highest.
9	Manikan Appavoo . . .	15 „	M.	19-9-98 (No. 1603)	„ „	12	1-10-98	4-10-98	9-10-98	...	„ „	5 „	T. 100·6° „
10	Fakira Sharappa . . .	3 „	M.	3-10-98 (No. 3301)	„ Corthorn	0	3-10-98	5-10-98	12-10-98	...	left axillary.	7 „	T. 102·3° on admission.
11	Yam Viruparksham Chidaram	12 „	M.	30-8-98 (No. 375)	„ Davidson	34	3-10-98	7-10-98	9-10-98	...	right and left axillary.	2 „	T. 99°.
12	Yam Munasvami Chidaram .	9 „	M.	8-9-98 (No. 980)	„ „	26	4-10-98	7-10-98	11-10-98	...	right groin.	4 „	T. 102·4° on admission.
13	Tingaya Tippana . . .	25 „	M.	7-10-98 (No. 4522)	„ Corthorn	II	5-10-98	7-10-98	13-10-98	...	„ femoral.	7 „	T. 102·4° on admission; inoculated during plague.
14	Luxmon Gopal . . .	18 „	M.	22-9-98 (No. 1803)	„ Davidson	14	6-10-98	10-10-98	20-10-98	...	left groin.	10 „	T. 103° on admission.
15	Mungappa Kom Bharmappa .	30 „	F.	9-9-98 (No. 1026)	„ „	30	9-10-98	10-10-98	15-10-98	...	right „	6 „	T. 102° „
16	Vallind Salu	9 „	M.	0-9-97	Civil Surgeon, Belgaum.	1 year	3-10-98	11-10-98	13-10-98	...	„ „	3 „	T. 99° highest.
17	Amendbi Hajeekha . . .	30 „	F.	19-9-98 (No. 1591)	Dr. Davidson	17	6-10-98	9-10-98	13-10-98	...	left axilla.	5 „	T. 103·8° on admission.
18	Mahomed Hajeekha . . .	7 „	M.	19-9-98 (No. 1594)	„ „	15	4-10-98	9-10-98	19-10-98	...	„ groin.	10 „	T. 103° highest.
19	Yellobai Kom Khandra . .	40 „	M.	10-10-98 (No. 5268)	„ Corthorn	2	12-10-98	14-10-98	19-10-98	...	right „	5 „	T. 103° on admission.

In column 7 roman figures show the number of days before inoculation in which an inoculated person was attacked.

Appendix No. XVI—*continued.*

Cases of Plague in the Dharwar Plague Hospital in inoculated persons—continued.

Number.	Name.	Age.	Sex.	Date of inoculation.	Doctor who inoculated.	Number of days between inoculation and attack.	Attack.	Admission.	Discharge.	Death.	Situation of bubo.	Days in hospital.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
20	Rajesab Mahomedsab . .	35 yrs.	M.	12-10-98 (No. 5454)	Dr. Corthorn	0	12-10-98	14-10-98	26-10-98	...	left groin and right parotid.	13 days.	T. 105°; this was a very serious case, the man getting well with great difficulty.
21	Yellappa Tamanna . . .	6 „	M.	6-10-98 (No. 4099)?	„ „	6	12-10-98	14-10-98	20-10 98	...	right groin	7 „	T. 104° on admission.
22	Basava Tamanna . . .	10 „	F.	6-10-98 (No. 4500)?	„ „	5	11-10-98	13-10-98	17-10-98	...	„ „	4 „	T. 102·2° highest.
23	Sawaka Oolappa . . .	20 „	F.	7-10-98 (No. 4731)	„ „	5	12-10-98	14-10-98	21-10-98	...	left „	8 „	T. 104° on admission.
24	Adirappa Gungappa . . .	25 „	M.	6-10-98 (No. 4010)	„ „	I	5-10-98	10-10-98	18-10-98	...	right „	9 „	T. 104·2° on admission; delirious.
25	Fakirudin Hakluna . . .	75 „	M.	3-10-98 (No. 3027)	„ „	5	8-10-98	9-10-98	12-10-98	...	„ axilla	4 „	T. 101° highest.
26	Amrilappa Ramji . . .	78 „	M.	28-9-98 (No. 2333)	„ „	8	6-10-98	8-10-98	12-10-98	...	left femoral	4 „	T. 99·2° highest.
27	Yellapa bin Taxawapa . .	16 „	M.	6-10-98 (No. 4087)	„ „	8	14-10-98	16-10-98	22-10-98	...	left axilla	6 „	T. 103·4° on admission.
28	Manappa Irappa . . .	30 „	M.	7-10-98 (No. 4784)	„ „	II	5-10-98	8-10-98	17-10 98	...	right groin	9 „	T. 103·8° highest.
29	Gungappa Mallappa . . .	22 „	F.	7-10-98 (No. 4832)	„ „	5	12-10-98	13-10-98	27-10-98	...	„ „	15 „	T. 105·4 highest; refused medical treatment for 6 days.
30	Bhimappa Manappa . . .	6 „	M.	7-10-98 (No. 4783)	„ „	0	7-10-98	8-10-98	11-10-98	...	left axilla	4 „	T. 102° on admission.
31	Bhagwant Luxmon . . .	16 „	M.	28-9-98(No. 2749)	„ „	10	8-10-98	10-10-98	16-10-98	...	right groin	7 „	T. 104·2° on admission.
32	Dhurmappa Ninigappa . .	31 „	M.	2-10-98 (No. 3125)	„ „	4	6-10-98	8-10-98	15-10-98	...	left femoral	8 „	T. 105° highest, 4th day.
33	Chumbasappa Giriappa . .	30 „	M.	5-10-98	„ „	6	11-10-98	17-10-98	20-10-98	...	right groin	4 „	T. 99·2° highest.
34	Anandabai Dajibai . . .	20 „	F.	10-10-98 (No. 5266)	„ „	2	12-10-98	14-10-98	21-10-98	...	no buboes	8 „	T. 104·2° on admission.
35	Gurappa Tippana . . .	19 „	M.	6-10-98 (No. 4379)	„ „	7	13-10-98	16-10-98	21-10-98	...	left groin	6 „	T. 102·2° „
36	Govind Narain . . .	22 „	M.	5-10-98 (No. 2481)	„ Winter	6	11-10-98	13-10-98	21-10-98	...	left groin and left axilla.	10 „	T. 105° „
37	Husenbi Rajesat . . .	12 „	F.	5-10-98 (No. 3749)	„ Corthorn	13	18-10-98	19-10-98	22-10-98	...	left groin	4 „	T. 98·5° highest.
38	Oolappa Baslingappa . .	30 „	M.	10-10-98 (No. 5302)	„ „	8	18-10-98	20-10-98	34-10-98	...	„ „	5 „	T. 103° „
39	Gafur Fakirudin . . .	16 „	M.	2-10-98 (No. 2995)	„ „	2	4-10-98	8-10-98	24-10-98	...	„ femoral	5 „	T. 103° on admission.

40	Rukhuabai Parmanand	55 „	F.	11-9-98 & 6-10-98 (No. 4025)	„ „	36	17-10-98	20-10-98	24-10-98	...	„ groin	5 „	T. 100° „ 101° highest.
41	Baslingappa Chumbasappa	25 „	M.	30-9-98 (No. 2432)	„ Davidson	13	13-10-98	18-10-98	26-10-98	...	„ „	9 „	T. 102° „
42	Sitabai Ramrao	30 „	F.	28-9-98 & 11-10-98 (No. 2350)	„ Corthorn	17	15-10-98	20-10-98	26-10-98	...	right axilla	7 „	T. 104° on admission.
43	Wazirlu Shumsudeen	12 „	F.	19-9-98 & 29-9-98 (No. 1883)	„ „	30	19-10-98	21-10-98	26-10-98	...	„ groin	6 „	T 101° highest.
44	Bhimava Nungappa	18 „	F.	6-10-98 (No. 4004)	„ „	15	21-10-98	23-10-98	27-10-98	...	left axilla	5 „	T. 102° on admission.
45	Gundappa Radrappa	13 „	M.	22-9-98 (No. 1722)	„ Davidson	26	18-10-98	19-10-98	28-10-98	...	„ groin	10 „	T. 102·8° „
46	Sonabai Subrao	20 „	F.	19-10-98 (No. 6242)	„ Corthorn	1	20-10-98	22-10 98	31-10-98	...	„ „	10 „	T. 104° on admission; abated 23rd, 4 p. m.
47	Rachava Pumappa	48 „	F.	16-9-98 & 7-10-98 (No. 1745)	„ „	16	23-10-98	25-10-98	31-10-98	...	„ „	7 „	T. 102·4° highest.
48	Nagawa Fakirappa	12 „	M.	16-10-98 (No. 5866)	„ „	5	21-10-98	24-10-98	3-11-98	...	right „	11 „	T. 104·4° on admission.
49	Fakirappa Gungappa	10 „	M.	21-10-98 (No. 6620)	„ „	5	26-10-98	29-10-98	5-11-98	...	right and left groins.	8 „	T. 102° „
50	Nellava Bhurmava	18 „	M.	7-10-98	„ „	22	29-10-98	31-10-98	6-11-98	...	right groin	6 „	T. 103° highest.
51	Bapoo Hariput	20 „	M.	1-9-98 & 16-9-98 (No. 349)	„ „	42	28-10-98	29-10-98	6-11-98	...	left axilla	9 „	T. 101·4° on admission.
52	Rahuabai Bhimrao	40 „	F.	14-10-98 (No. 5738)	„ „	9	23-10-98	27-10-98	7-11-98	...	„ femoral	12 „	T. 102° highest.
53	Rahimbi Shaik Hussain	20 „	F.	17-10-98 (No. 6088)	„ „	7	24-10-98	27-10-98	7-11-98	...	left axilla and right groin.	12 „	T. 102·6° on admission.
54	Kadirsab Fakirsab	50 „	M.	28-9-98 & 14-10-98 (No. 2379)	„ „	15	29-10-98	31-10-98	8-11-98	...	left groin	8 „	T. 101° „
55	Abdul Abdulnabi	20 „	M.	2-10-98 (No. 6547)	„ „	19	21-10-98	26-10-98	8-11-98	...	„ „	14 „	T. 103° „
56	Ischwaraya Fakiraya	38 „	M.	21-10-98 (No. 6452)	„ „	7	28-10-98	31-10-98	8-11-98	...	right femoral	9 „	T. 102·6° highest.
57	Gungava Joliba	25 „	M.	3-10-98 & 13-10-98 (No. 3136)	„ „	25	7-11-98	8-11-98	14-11-98	...	„ groin	7 „	T. 104° on admission.
58	Renava Nagappa	11 „	F.	2-10-98 & 16-10-98 (No. 3056)	„ „	17	2-11-98	10-11-98	14-11-98	...	left axilla and left groin.	5 „	T. normal.
59	Govind Basappa	22 „	M.	15-10-98 (No. 5812)	„ „	13	28-10-98	31-10-98	15-11-98	...	left femoral and left parotid.	16 „	T. only once above 100, *viz.*, 102° 14th day of illness.
60	Krishnarao Shrineevasrao	35 „	M.	22-9-98 (No. 1836)	„ Davidson	36	28-10-98	2-11-98	17-11-98	...	left femoral	16 „	T. 102·6° on admission.
61	Malava Fakirappa	4 „	F.	21-9-98 & 18-10-98 (No. 1976)	„ Corthorn	14	1-11-98	10-11-98	19-11-98	...	„ axilla	10 „	T. 102·6° highest.
62	Hunmant Krishna	40 „	M.	1-9-98 (No. 569)	„ Davidson	53	26-10-98	28-10-98	19-11-98	...	right supratrochlear.	22 „	T. 101 2° on admission.
63	Haumantappa Timappa	30 „	M.	6-11-98	„ Corkery	I	5-11-98	9-11-98	23-11-98	...	right groin	15 „	T. 104·2° highest; inoculated during plague.
64	Basaya Shivlingaya	64 „	M.	2-10-98 & 16-10-98 (No. 3105)	„ Corthorn	17	2-11-98	10-11-98	82-11-98	...	left „	19 „	T. 101° on admission.

In column 7 roman figures show the number of days before inoculation in which an inoculated person was attacked.

Appendix No. XVI—*continued.*

Cases of Plague in the Dharwar Plague Hospital in inoculated persons—concluded.

Number.	Name.	Age.	Sex.	Date of inoculation.	Doctor who inoculated.	Number of days between inoculation and attack.	Attack.	Admission.	Discharge.	Death.	Situation of bubo.	Days in hospital.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
65	Fakirappa Balappa . . .	34 yrs.	M.	30-10-98 (No. 7302)	Dr. Corthorn	10	9-11-98	12-11-98	28-11-98	...	right groin	17 days	T. 104·8° on admission.
66	Bayama Laxmaya . . .	27 „	F.	4-10-98 & 16-10-98	„ „	19	4-11-98	9-11-98	29-11-98	...	„ axilla	19 „	T. 102·6° highest.
67	Tamanappa Bhimrao . . .	35 „	M.	22-9-98 (No. 1971)	„ „	35	27-10-98	1-11-98	1-12-98	...	left „	31 „	T. 103·2° „
68	Chumappa Malkappa . .	35 „	M.	23-8-98 (No. 397)	„ Davidson	68	30-10-98	1-11-98	...	3-11-98	pneumonic plague.	3 „	T. 102·4° on admission.
69	Bhimabai Tukaram . . .	22 „	F.	27-9-98 (No. 2173)	„ „	42	8-11-98	12-11-98	...	13-11-98	left femoral	2 „	T. 101° „
70	Ramia Ishwarappa . . .	5 „	M.	20-9-98 (No. 1740)	„ „	51	10-11-98	12-11-98	...	13-11-98	„ cervical	1 „	T. 97° „
71	Budhwant Peter . . .	16 „	M.	23-8-98	„ „	82	14-11-98	18-11-98	...	18-11-98	left axilla	4½ hours.	T. 104·4° „
72	Fakirappa Peerappa . . .	35 „	M.	1-9-98 (No. 449)	„ „	76	16-11-98	17-11-98	...	20-11-98	„ „	3 days	T. 105·4° on admission; this was only pneumonic.
73	Awinsab Hatelsab . . .	6 „	M.	16-11-98 (No. 8467)	„ Corthorn	0	16-11-98	18-11-98	...	28-11-98	„ „	8 „	T. 105° on admission; inoculated during plague and cholera death due to the latter.
74	Luxmon Dinanath . . .	7 „	M.	19-9-98 (No. 1335)	„ Davidson	0	19-9-98	22-9-98	...	27-9-98	„ groin	6 „	T. 104°; never below 103°.
75	Mullarirao Sheshgiri . . .	7 „	M.	2-9-98 (No. 620)	„ „	26	28-9-98	2-10-98	...	4-10-98	„ „	2 „	T. 102° on admission.
76	Tulgobai Khandobai . . .	20 „	F.	1-10-98 (No. 2879)	„ Corthorn	0	1-10-98	3-10-98	...	6-10-98	„ axilla	3 „	T. 105° „
77	Rajabai Sheshgiri . . .	22 „	F.	28-9-98	„ Davidson	2	1-10-98	2-10-98	...	7-10-98	right cervical	6 „	T. 105° „
78	Gungappa Fakirgonda . .	65 „	M.	16-8-98 (No. 29)	„ „	49	4-10-98	6-10-98	...	10-10-98	„ „	4 „	T. 103° „ and pneumonic.
79	Abdulkarim Abdulsab . .	40 „	M.	27-9-98 (No. 2239)	„ „	11	8-10-98	9-10-98	...	10-10-98	left groin	1 „	T. 100° highest.
80	Malava Oolappa . . .	40 „	F.	5-12-98 (No. 3714)	„ Corthorn	1	6-10-98	11-10-98	...	12-10-98	„ cervical	1 „	T. 103° on admission.
81	Sungappa Chumbasappa . .	60 „	M.	23-8-98 (No. 132)	„ Davidson	47	9-10-98	11-10-98	...	14-10-98	right groin	3 „	T. 105° „
82	Chandbi Mohidinsab . .	60 „	F.	12-10-98	„ Winter	0	12-10-98	14-10-98	...	16-10-98	no gland	36 hours	T. 102·8° „
83	Rajesab Maehunsab . . .	25 „	M.	12-10-98	„ Corthorn	0	12-10-98	14-10-98	...	17-10-98	left groin	4 days	T. 104° „

84	Balwant Narayan . . .	30 ,,	M.	13-10-9 (No. 5703)	,, ,,	0	13-10-98	6-10-98	...	20-10-98	no gland	5 ,,	T. 104° ,,
85	Luxmibai Raojirao . . .	15 ,,	F.	17-10-98 (No. 6055)	,, ,,	2	19-10-98	23-10-98	...	23-10-98	left cervical	6 hours	T. 103° ,,
86	Krishnaji Madhav . . .	28 ,,	M.	22-9-98 (No. 1871)	,, Davidson	15	7-10 98	20-10-98	...	24-10-98	right groin	4 days	T. 103° highest.
87	Shiwava Baslingappa . .	55 ,,	F.	5-10-98 (No. 3705)	,, Corthorn	17	22-10-98	25-10-98	...	25-10-98	left axilla	1 day	T. 102° on admission
88	Akhersab Mohidinsab . .	30 ,,	M.	6-10-98	,, ,,	12	18-10-98	20-10-98	...	26-10-98	right groin	6 days	T. 105° highest.
89	Basappa Timmappa . . .	50 ,,	F.	29-9-98 and 10-10-98	,, ,,	9	19-10-98	25-10-98	...	26-10-98	,, ,,	1 day	T. 103° ,,
90	Nanikhan Hajeekhan. . .	16 ,,	M.	2-9-98 (No. 627)	,, Davidson	45	17-10-98	19-10-98	...	27-10-98	left axilla	9 days	T. 102° highest and second pneumonic.
91	Pursoo Piraji	3 ,,	M.	23-9-98 (No. 1914)	,, ,,	31	24-10-98	27-10-98	...	27-10-98	,, ,,	12 hours	T. 104° on admission.
92	Luxmibai Naranrao . . .	35 ,,	F.	14-9-98 and 11-10-98 (No. 1538)	,, Corthorn	9	20 10-98	22-10-98	...	28-10-98	,, cervical	7 days	T. 103·2° highest.
93	Hussain Timanma . . .	30 ,,	M.	17-5-98 and 20-5-98	,, Leumann	156	23-10-98	26-10-98	...	29-10-98	right axilla and pneumonic.	4 ,,	T. 104° ,,
94	Oolappa Luxumappa . .	35 ,,	M.	6-10-98 (No. 4503)	,, Corthorn	13	19-10-98	21-10-98	...	26-10-98	right groin and pneumonic.	6 ,,	T. 105° ,,
95	Mahomedsab Rajesab . .	40 ,,	M.	15-10-98 (No. 5826)	,, ,,	3	18-10-98	23-10 98	3-11-98	...	right groin	12 ,,	T. 103·4° on admission.
96	Khrisnaji Madhao . . .	28 ,,	M.	22-9-98	,, Davidson	14	6 10-98	20-10-98	24-10-98	...	,, femoral	4½ ,,	T. 99·4 highest.
97	Parvatana Maharudrappa . .	10 ,,	F.	21-9-98 and 7-10-98 (No. 1975).	,, Corthorn	41	17-11-98	17-11-98	...	...	...	...	Convalescent ; bubo left groin. Burst on 23-11-98.
98	Shidlingaya Dhondaya. . .	40 ,,	M.	13-10-98 and 31-10-98 (No. 5660).	,, ,,	17	17-11-98	19-11-98	...	...	...	...	Convalescent ; bubo right groin. Burst on 26-11-98.
99	Mahomed Hussan . . .	40 ,,	M.	5-10-98 (No. 2479)	,, Winter	19	24-10-98	27-10-98	...	...	...	...	Convalescent; bubo left femoral. Opened 4-11-98.

Four cases in which persons were inoculated when plague had already manifested itself. None fatal.
Nine cases in which onset of plague arose within 24 hours of inoculation.

Recoveries	69
Deaths	27
Convalescent	3
	99

Appendix No. XVI—*continued.*

Cases of Plague in Dharwar in inoculated persons outside the Plague Hospital.

Number.	Name.	Age.	Sex.	Date of inoculation.	Doctor who inoculated.	Number of days between inoculation and attack.	Attack.	Reported.	Recovery.	Death.	Situation of bubo.
1	2	3	4	5	6	7	8	9	10	11	12
1	Bhagwan Basudew Reye . .	...	...	2-9-98	Dr. Davidson .	8	10-9-98	...	...	...	Left axilla, left cervical.
2	Durgabai Reye	11 yrs.	F.	2-9-98 (No. 630)	,, ,,	15	17-9-98	...	...	22-9-98	...
3	In House No. 2636, Ward XV, a boy	12 ,,	M.	14-9-98	...	...	...	...	...	...	Has enlarged gland in right groin ; dangerously ill (20-9-98).
4	Bhimappa Horappa . . .	30 ,,	M.	22-9-98	Dr. Davidson.	...	...	...	...	4-10-98	...
5	Ramarao Manjunath . . .	26 ,,	M.	Twice inoculated, Hubli ; one date, 18-7-98.	,, Cardoz .	...	...	...	...	25-9-98	...
6	Israel Bamanik	55 ,,	M.	13-9-98	,, Davidson .	...	...	...	...	18-9-98	...
7	Vaiayak Gopal Kirloskar . .	35 ,,	M.	1-9-98 and 8-9-98 (two half dozes).	,, ,,	30	8-10-98	...	...	12-10-98	Bubo right groin.
8	Bhima Narayan	9 ,,	M.	14-9-98 and 22-9-98 (two full doses).	,, ,,	1	23-9-98	...	12-10-98	...	Did not suffer after first inoculation, but after second had high fever and buboes in the right armpit and right groin.
9	Allabaksh Hussansab . . .	5 ,,	M.	Two inoculations ; second on 9-9-98 half doses.	,, ,,	16	25-9-98	...	12-10-98	...	Buboes left armpit and right groin (armpit bubo suppurated). During childhood was subject to convulsions which re-appeared after second inoculation. For two or three days he got fits and was unconscious. Was doing well on 12th October 1898.
10	Elizabeth DeCruz . . .	18 ,,	F.	5-10-98	,, Winter .	0	5-10-98	...	...	12-10-98	...
11	Sundrabai Pandba . . .	4 ,,	F.	27-9-98	,, Davidson	8	5-10-98	7-10-98	...	Died date unknown.	...
12	Sittoba Subrao	Infant	M.	1-10-98 (No. 2880)	,, Corthorn .	...	...	...	...	7-10-98	Died of convulsions.
13	Basappa Fakira	35 yrs.	M.	12-10-98	,, Winter .	0	12-10-98	14-10-98	19-10-98	...	Buboes on right and left groins. T. 100° on admission.
14	Abdulsab Mahomedsab . .	20 ,,	M.	5-10-98	,, ,, .	1	6-10-98	13-10-98	death14-10-98	...	Buboes left groin and left axilla. T. 102° on admission.
15	Shevamurtepa Tippanna . .	22 ,,	...	7-10-98 (No. 4535)	,, Corthorn .	3	12-10-98	13-10-98	...	14-10-98	...
16	Luxman Saulobai . . .	5 ,,	M.	5-10-98 (No. 3594	,, ,, .	8	13-10-98	...	...	...	...

17	Mahadew Gursa Mutabi	23 ,,	M.	5-9-98 and 28-9-98 (No. 880)	,, ,,	18	16-10-98	...	...	22-10-98	Bubo right groin.
18	Tammaya Bhimappa	20 ,,	M.	7-10-98 and 16-10-98 (No. 4813).	,, ,,	...	...	...	...	Died of plague date unknown	...
19	Virappa Mintappa	50 ,,	M.	21-9-98 and 18-10-98 (No. 1983).	,, ,,	...	...	...	...	Died of plague date unknown	...
20	Gunpat Krishnaji Tikari	28 ,,	...	Inoculated once	,, Davidson	...	...	...	...	Died of plague 17-10-98	...
21	Indrabai Gururao	...	...	16-9-98 and 6-10-98 (No. 1721)	,, Corthorn	...	...	18-10-98 (reported).	...	...	Fever with bubo.
22	Mahhava Gururao	...	...	Inoculated twice	,, ,,	...	...	20-10-98 (reported).	...	...	...
23	Narayan Rangachanga	12 yrs.	M.	17-9-98 and 29-9-98 (No. 1823)	,, ,,		...	27-10-98	...	27-10-98	......
24	Mellaya bin Chenabasaya	40 ,,	M.	Once inoculated	,, ,,		...	9-11-98	...	...	......
25	Neelava Kom Andraya	25 ,,	F.	Twice ,,	,, ,,		...	...	...	...	......
26	Mallapa bin Chimapa	17 ,,	M.	,, ,,	,, ,,		...	...	...	...	......
27	Chinaya Israel	22 ,,	M.	12-10-98 (No. 5476)	,, ,,	8	20-10-98	...	12-11-98	...	Bubo right groin (burst).
28	Meera Bapoo	50 ,,	M.	23-9-98 (No. 2109)	,, Davidson	14	7-10-98	...	26-10-98	...	......
29	Suntram Luxmon	16 ,,	M.	11-10-98 (No. 5374)	,, Corthorn	15	26-10-88	...	9-11-98	...	Bubo left femoral.
30	Jamabai Halelsab	4 ,,	M.	16-11-98 (No. 8468)	,, ,,	...	6-9-98	...	2-10-98	...	... ...
31	Ningappa Basappa	45 ,,	M.	7-10-98 (No. 4538)	,, ,,	14	21-10-98		14-11-98	...	Bubo left femoral (burst).
32	Rajina Kom Bhikumsab	30 ,,	F.	Had plague one month ago,	was recovered by 4th	November	ber 1898, and	then got in	oculated by	Dr. Corthorn	......
33	Rajaram Badappa	22 ,,	M.	12-10-98 (No. 5568)	Dr. Corthorn	4	16-10-98	...	31-10-98	...	Bubo right groin.
34	Abdoola Bandoomia	14 ,,	M.	31-8-98 (No. 396)	,, Davidson	51	21-10-98	...	6-11-98	...	......
35	Rahembi Bandoobhai	10 months	M.	2-9-98 (No. 625)	,, ,,	14	16-9-98	...	24-9-98	...	Bubo left groin.
36	Mohidinsab Mahombedsa	22 yrs.	M.	22-10-98 (No. 9905)	,, Hill	4	26-10-98	...	14-11-98	...	......
37	Changuna Rama	30 ,,	F.	8-10-98 (No. 4872)	,, Corthorn	1	9-10-98	...	24-10-98	...	Got fever a few hours after inoculation; first noticed right parotid; gland painful and enlarged, 12th October 1898; bubo burst; fever did not subside between inoculation and enlargement of gland.
38	Amabai Mankoba	35 ,,	F.	22-9-98 (No. 1923)	,, Davidson	20	12-10-98	...	27-10-98	...	Bubo left groin.
39	Ventrao Ael	35 ,,	M.	1-9-98 and 25-9-98	,, Corthorn	19	14-10-98	...	14-11-98	...	Bubo left axilla and right groin.
40	Wife of Ventrao	...	F.	25-9-98	,, ,,	3	28-9-98	...	20-10-98	...	Bubo right groin.

Summary.—99 inoculation cases treated in hospital; 16 among twice inoculated and 83 among once inoculated.
40 ,, ,, among persons who did not come into hospital; of the 40, 13 were among twice inoculated.
27 ,, ,, once ,,
40

DHARWAR;
The 8th December 1898.

R. W. HORNABROOK, M.B.,
Special Medical Plague Officer.

App. xvi.

Appendix No. XVI—*continued.*

Further Record of Cases of Plague in Dharwar among persons inoculated with Professor Haffkine's Prophylactic.

Number.	Name.	Age.	Sex.	Date of inoculation.	Doctor who inoculated.	Number of days between inoculation and attack.	Attack.	Recovery.	Death.	Situation of bubo.
1	2	3	4	5	6	7	8	9	10	11
1	Luxmon Kushnath	34 years	M.	30-11-98	Dr. Hornabrook.	4	3 12-98	16-12-98	...	right groin.
2	Mammigappa Irappa	30 „	M.	6-10-98 and 30-10-98	„ Corthorn.	29	28-11-98	12-12-98	...	left „
3	Bhimappa Pirappa	12 „	M.	6-10-98 and 25-10-98	„ „	9	3-11-98	23-11-98	...	right „
4	Bhimava Mallappa	16 „	F.	5-10-98 and 26-10-98	„ „	...	?	...	25-11-98	not stated.
5	Meera Bapoo	50 „	M.	23-9-98	„ Davidson.	14	7-10-98	26-10-98	...	„ „
6	Suntram Luxmon	16 „	M.	11-10-98	„ Corthorn.	15	26-10-98	9-11-98	...	left femoral.
7	Mugappa Basappa	45 „	M.	7-10-98	„ „	14	21-10-98	14-11-98	...	„ „
8	Rajaram Badappa	22 „	M.	12-10-98	„ „	4	16-10-98	31-10-98	...	right groin.
9	Abdooba Bandoomia	14 „	M.	31-8-98	„ Davidson.	51	21-10-98	6-11-98	...	not stated.
10	Rokembi Bandoobhai	16 months	...	2-9-98	„ „	14	16-9-98	24-9-98	...	left groin.
11	Mohidinsab Mahomedsab	22 years	M.	22-10-98	„ Hill.	4	26-10-98	14-11-98	...	not stated.
12	Changuna Rama	30 „	F.	8-10-98	„ Corthorn.	4	12-10-98	27-10-98	...	right parotid.
13	Amabai Mankoba	35 „	F.	22-9-98	„ Davidson.	20	12-10-98	27-10-98	...	left groin.
14	Chimaya Israel	22 „	M.	12-10-98	„ Corthorn.	8	20-10-98	12-11-98	...	right „
15	Khrisnabai Khandba	6 „	F.	27-9-98 and 10-11-98	„ Davidson.	7	17-11-98	5-12-98	...	„ femoral.
16	Irappa Parappa	60 „	M.	25-11-98	„ Corthorn.	2	27-11-98	10-12-98	...	not stated.
17	Virappa Minbappa	50 „	M.	21-9-98 and 18-10-98	„ „	...	?	...	...	died of plague in jungle.
18	Tanmappa Bhimappa	20 „	M.	7-10-98 and 16-10-98	„ „	...	?	...	...	„ „ „ „ „
19	Shivanmitepa Tippanna	22 „	M.	7-10-98	„ „	3	11-10-98	...	13-10-98	plague; situation of bubo not stated.
20	Hanifama Moidin	60 „	F.	29-9-98	„ „	12	11-10-98	...	13-10-98	„ „ „ „ „
21	Maharudra Chamaya	14 „	M.	12-10-98	„ „	15	27-10-98	14-11-98	...	left cervical.
22	Iraya Guruaya	14 „	M.	12-10-98	„ „	4	16-10-98	16-11-98	...	right groin.
23	Ghondusab Mannasab	40 „	M.	23-11-98	„ Hornabrook.	7	30-11-98	17-12-98	...	left axilla.
24	Lawanka Basappa	25 „	F.	6-11-98	„ Corthorn.	8	14-11-98	26-11-98	...	„ groin.
25	Ram Chandra Shrinivas	12 years	M.	26-11-98	Dr. Hornabrook.	1	27-11-98	8-12-98	...	left groin.
26	Chimapa Shivanapa	34 „	M.	7-12-98	„ „	1	8-12-98	21-12-98	...	„ „
27	Jrawa Kotu	20 „	F.	28-9-98	„ Corthorn.	10	8-10-98	...	13-10-98	left cervical.
28	Narsabai Gopal charya	25 „	F.	15-9 98	„ Davidson.	88	12-12-98	...	22-12-98	right axilla and pneumonic.
29	Tanmappa Basappa	70 „		26-10-98 and 6-11-98	„ Corthorn.	46	22-12-98	...	23-12-98	pneumonic plague.

30	Juyanappa Shirappa	60 „	F.	7-9-98 and 29-9-98	„ Davidson.	85	23-12-98	...	26-12-98	„
31	Basava Fakirappa	8 „	F.	23-9-98	„ „	46	8-11-98	8-12-98	...	left axilla.
32	Tipana Shivrudraya	12 „	F.	23-9-98	„ „	17	10-10-98	20-10-98	...	right groin.
33	Ulawa Madiwalappa	40 „	M.	1-11-98 and 7-11-98	„ Corkery.	44	21-12-98	...	26-12-98	pneumonic plague.
34	Bharmava Gyanappa	50 „	F.	7-9-98 and 27-9-98	„ Corthorn.	91	27-12-98	...	2-1-98	„ „
35	Tivofii Ratnappa	2 „	M.	7-9-98 and 27-9-98	„ „	96	1-1-99	9-1-99 (convalescent)	...	pneumonic and left groin.
36	Gurupa Gurrabasapa	19 „	M.	20-9-98	„ Davidson.	49	8-11-98	8-12-98	...	left groin.
37	Virsabai Subbapati	8 „	F.	16-9-98	„ „	3	19-9-98	...	21-9-98	„ axilla.
38	Gangabai Vishnu	40 „	F.	23-9-98	„ „	7	30-9-98	...	4-10-98	not stated.
39	Maitande Khrisnaji	35 „	M.	27-9-98	„ „	8	5-10-98	...	8-10-98	„
40	Sarfudeen Hayalsab	3 „	M.	27 9-98	„ „	9	6-10-98	...	9-10-98	„
41	Rajasab Nabisab	30 „	M.	Twice inoculated	„ Corthorn.	...	8-10-98	...	10-10-98	„
42	Santawa Anandroa	4 „	F.	11-9-98	„ Davidson.	27	8-10-98	...	10-10-98	„
43	Maliawa Basappa	35 „	F.	8-10-98	„ Corthorn.	1	9-10-98	...	11-10-98	„
44	Gungabai Gangapi	12 „	F.	Once inoculated	„ „	...	10-10-98	...	12-10-98	„
45	Magobasappa Shivappa	80 „	M.	6-10-98	„ „	8	14-10-98	...	15-10-98	Fever came on 36 hours after inoculation. Bubo, right groin, appeared on fourth day.
46	Rabesab Hussensab	25 „	F.	Twice inoculated	„ „	...	16-10-98	...	18-10-98	Not stated.
47	Mahaven Mukasi	23 „	M.	5-9-98 and 28-9-98	„ „	18	16-10-98	...	22-10-98	„
48	Javarbi Katekhan	10 „	F.	14-10-98	„ „	7	21-10-98	...	23-10-98	not stated.
49	Bandu Dadumna	40 „	M.	20-10-98	„ „	2	22-10-98	...	24-10-98	„
50	Rukmabai Dhondibai . . .	60 „	F.	Once inoculated	„ Davidson	...	22-10-98	...	24-10-98	„
51	Manbi Morgasab	9 „	F.	19-10-98	„ Corthorn	3	22-10-98	...	24-10-98	„
52	Rangubai Raghvendras . . .	7 „	F.	Twice inoculated	„ „	...	22-10-98	...	24-10-98	„
53	Venkaji Govind . . .	40 „	M.	Once „	„ Davidson	...	23-10-98	...	25-10-98	„
54	Rajama Venkappa	30 „	F.	21-9 98	„ „	32	23-10-98	...	26-10-98	„
55	Narayan Huballi	12 „	M.	17-9-98 and 29-9-98	„ Corthorn	27	26-10-98	...	26-10-98	right groin.
56	Bibisab Hayalsab . . .	20 „	F.	2-10-98	„ „	23	25-10-98	...	27-10-98	not stated.
57	Mallappa Chumbasappa . . .	55 „	M.	3-10-98	„ „	22	25-10-98	...	27-10-98	„
58	Jansambad Jalab	70 „	M.	25-10-98	„ „	1	26-10-98	...	28-10-98	„
59	Chinonanna Josif	45 „	F.	10-10-98	„ „	16	26-10-98	...	27-10-98	„
60	Appa Bhan Divekar . . .	30 „	M.	Twice inoculated	„ „	...	30-10-98	...	1-11-98	„
61	Mugappa Mallappa	50 „	M.	3-10-98 and 25-10-98	„ „	9	3-11-98	...	6-11 98	„
62	Sidlana Bhurmappa	40 „	F.	Twice inoculated	„ „	...	4-11-98	...	7-11-98	„
63	Parsharam Narsinga . . .	12 „	M.	Once „	„ „	...	14-12-98	...	15-12-98	„

All persons inoculated by Drs. Corthorn, Corkery, Hill, Winter or Hornabrook were inoculated in the left arm.

The majority of Dr. Davidson's in the right arm.

In *all* cases where the situation of the bubo is "Not stated" the officer granting the certificate of plague death has failed to mention the situation of the bubo, though recording the other details.

Appendix No. XVI—*concluded.*

Record of Cases of Plague in Dharwar amongst inoculated persons—concluded.

Number.	Name.	Age.	Sex.	Date of inoculation.	Doctor who inoculated.	Number of days between inoculation and attack.	Attack.	Recovery.	Death.	Situation of bubo.
1	2	3	4	5	6	7	8	9	10	11
64	*Imam Hiru	20 "	M.	1-1-098 and 14-10-98	" "	89	11-1-99	...	15-1-99	pneumonic plague.
65	*Choti N. Dustgir	30 "	F.	6-1-99	" Hornabrook	4	10-1-99	20-1-99 (convalescent)	...	" "
66	*Herubhai Chiloba	70 "	M.	Held exemption pass	for inoculation.	...	9-1-99	...	15-1-99	" "
67	Gungawa Muppaya	24 "	F.	5-10-98 (No. 3747)	Dr. Corthorn	10	25-10-98	26-11-98	fever, 25-10-98	bubo left groin, 26-10 98; fever lasted 10 days; bubo burst, 4-11-98.
68	Luxmibai Bhundoo . . .	30 "	F.	8-9-98 (No. 1252)	" "	15	23-9-98	29-10-98	23-9-98	left femoral, gland and fever; 5-10-98 fever subsided; 14-10-98 gland burst.
69	Guanappa Gunjala	45 "	M.	7-9-98 and 27-9-98	" "	87	23-12-98	...	26-12-98 (death)	pneumonic plague.

* The above *three* are all of the same family, and all lived in same house.

In *all* cases where the situation of the bubo is "Not stated" the officer granting the certificate of plague death has failed to mention the situation of the bubo, though recording the other details.

DHARWAR;
The 9th January 1899.

R. W. HORNABROOK, M.B., M.R.C.S.,
Special Plague Medical Officer.

APPENDIX No. XVII.

NOTES ON

A CASE OF ACUTE PLAGUE SEPTICÆMIA, WITH POST-MORTEM EXAMINATION

BY

SURGN.-CAPT. B. H. F. LEUMANN, M.B., LOND., I.M.S.,
In charge of Sholapur Plague Hospital.

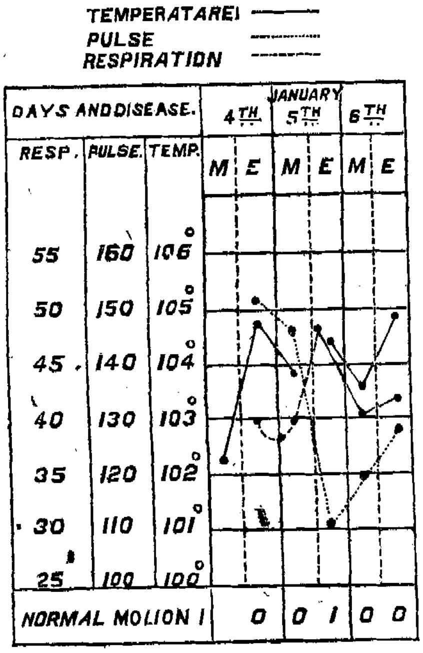
V. N., aged 32 years, Hindu, weaver, was admitted into the Plague Hospital, Sholapur, on the morning of the 4th January 1898.

He stated that he had been ill for nearly three days, and presented all the typical signs of plague. His temperature on admission was 102·4° Fahr.; pulse, soft and dicrotic; respiration-rate, increased. In the left inguinal region was a hard, painful bubo, the size of a small hen's egg.*

The following day he was delirious and tossing about, his bubo had enlarged considerably, and the left iliac glands were also found swollen and tender. In the evening he lay in low muttering delirium, wholly unconscious, and the bubo was noticed to be much larger and surrounded by œdema.

On the 6th instant he rallied slightly in the morning' and expressed himself as better, but he soon relapsed into low delirium and continued unconscious, passing his evacuations into the bed, until he died at 4-30 P.M.

(Temperature, pulse and respiration chart attached.)



Post-mortem—18 hours after death. Body well nourished. Rigor mortis markedly present. No bruises on head, body or arms. On dorsum of left foot a small circular sore at base of big toe, and another small abrasion just below ankle in middle line.

On ocular and palpebral conjunctivæ several petechiæ about the size of millet-seeds; also on inner side of lips and gums over upper and lower incisor teeth.

Large diffused bubo 3" long by 2" broad in left Scarpa's triangle surrounded by œdema and apparently continuous with bubo in left iliac region. Skin not discoloured over either. No other superficial glandular enlargement.

On opening body, nothing abnormal noted in body-walls; ʒi of serous fluid in pericardium; petechiæ on surface of both lungs in the visceral pleura, but none in parietal pleura.

Pharynx and Larynx—Shewed small petechiæ with mucosa injected throughout.

Œsophagus—Also shewed an injected mucosa.

Lungs—Œdematous and bronchitic. A few old pleuritic adhesions at right apex anteriorly and laterally. Numerous hæmorrhages and petechiæ in the fold between upper and lower lobes of both lungs and also on their anterior surfaces. Hypostatic congestion at bases and behind. On section much frothy, bloody, mucoserous exudation which also filled the bronchi. Slight hæmorrhages, irregularly scattered throughout the lungs, were seen on section.

Heart—About 12-30 minute petechiæ on visceral pericardium, on anterior surface of left and right ventricle near the apex, and a few on parietal pericardium at base of the big vessels. Muscle-substance, soft and œdematous. Right ventricle slightly dilated. All the cavities of the heart filled with *ante* and *post-mortem* clots; and the right ventricle, right auricle and large veins entering it contained much dark, tarry-looking, very liquid blood. Valves of heart apparently normal, and no hæmorrhages or petechiæ seen on internal walls.

Aorta—Almost empty of blood; coats appeared normal. Ditto pulmonary veins, but pulmonary arteries contained a little dark blood.

Abdomen—No fluid in peritoneal cavity. Intestines much inflated, and numerous petechiæ showing through the walls of the ileum, jejunum, descending colon and sigmoid flexure. Bladder distended with about ʒviii of urine. On moving the intestines laterally a large, blood-stained, sausage-shaped mass composed of numerous conglomerated glands felt along and surrounding the left iliac vessels. The peritoneum covering this tumour was infiltrated with sanguineous matter, thickened and presenting hundreds of small hæmorrhages and petechiæ, which condition was also carried down into the pelvis on the left side. Right side, normal apparently.

Liver—Enlarged in size, deeply congested on all surfaces with large irregular stellate hæmorrhages spreading into its superficial substance laterally from blood effusions in its anterior, upper and falciform ligaments. A pale yellowish necrotic patch, irregular in shape, and about 2" square in size, extending about ½ to ¾" into the substance of the organ, was seen on its anterior surface, spreading from the middle line on to both lobes. The gall-bladder was embedded in a mass of hæmorrhagic matter, and presented two large hæmorrhages laterally placed on its outer surface.

On section the liver was soft, bloody and friable, the branches of the portal vein exuding dark liquid blood. No separate hæmorrhages detected in its interior.

The Gall-bladder—Presented hæmorrhages, as stated, externally, and contained about ʒiii of dark, coal-tarry, viscid, bloody-looking bile, which had deeply stained its honey-combed mucosa, but there were no hæmorrhages visible internally. The bile-duct was patent.

Pancreas—A small irregular hæmorrhage over the surface of its "tail," but its section presented a normal appearance.

Spleen—Enlarged to twice its size, dark red on surface, with 2 or 3 irregular hæmorrhages at its hilum. Section very soft, bloody, mulberry-like in consistence, with numerous petechiæ and hæmorrhages (infarcts). The whole organ was embedded in bloody œdema which had evidently spread from below.

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* No other superficial glandular enlargement. Thoracic and abdominal organs apparently normal.

Kidneys—Right kidney showed a small dark-red clot in the pelvis, but was otherwise apparently normal. Left kidney embedded in bloody œdema which extended all round it, penetrating its capsule, but not the kidney itself. Section revealed one small hæmorrhage in the upper part of the pelvis of the organ, but its structure otherwise did not look abnormal.

Ureters—Right ureter normal, without and within. Left ureter appeared normal for about one inch below the left kidney, but after this was swollen to twice the size of that on the right side, dark-red in colour and lying deep in the bloody extravasation which extended all along the left flank. Only its sheath, however, was infiltrated with this blood-stained œdema, for its lumen and walls appeared perfectly pale.

Supra-renal bodies—Right, natural; left, slightly hæmorrhagic on surface and on section, and swollen to twice the size of the right one.

Bladder—Contained about ℥viii of clear dark-coloured urine, but its coats presented quite a normal appearance, and no petechiæ were seen in its mucosa.

Stomach—Dilated, containing much greenish, grumous matter. On its peritoneal coat were numerous hæmorrhages along its greater curvature. All its coats were œdematous and thickened. The mucosa shewed prominent injected ridges, with myriads of petechiæ of all sizes irregularly scattered about from pyloric to cardiac end, but more numerous at the latter, bright red in colour, and standing out in prominent contrast to the other paler portion. The pylorus appeared normal on section.

Duodenum—Œdematous and slightly injected and with a few petechiæ, of which there were more in the *jejunum* and *ileum*. In this latter Peyer's patches appeared somewhat swollen and œdematous, and were slightly injected, but not eroded or otherwise inflamed.

Large Intestine—Shewed a few irregularly-scattered petechiæ and small hæmorrhages visible through all its coats.

The Lymphatic system—In the left Scarpa's triangle a pear-shaped hæmorrhagic mass 2″ × 3″ × 2″ lying embedded in much sero-bloody œdema, entirely surrounding the femoral vessels and upper portion of the Δ. The saphena vein was dissected out with difficulty. On section the mass was found to consist of several large glands irregularly infiltrated with blood throughout and fusing above into the bloody extravasation which extended through Poupart's ligament, staining it deeply, on to the left iliac fossa and into the left side of the pelvis, and was continued further up along the left flank as far as the spleen, involving everything in its course,—iliac vein and glands, vena cava inferior, retro-peritoneal glands, etc.

The left Iliac Glands—Were also enlarged to the size of walnuts, dark-red on surface and section, very soft and lying on the iliac vessels which had been directly infiltrated with hæmorrhage from them through their walls, shewing the intima, especially of the veins, stained deeply with irregular hæmorrhages. This staining had also involved the peritoneum over the glands and passed deeply into the pelvic fascia, and along the left lateral ligament of the bladder, infiltrating and involving all the glands and other structures in its course. Thus the ilio-psoas muscle of that side, the left ureter, and the iliac fascia appeared sodden and dark-coloured with this bloody œdema.

The right femoral, inguinal, and iliac glands appeared enlarged and very slightly hæmorrhagic, while the vessels on that side appeared normal on surface, and throughout their coats,—their intima being pale and in no way altered or stained.

[The spermatic cord on the left side was also involved in the general œdema around the glands and thickened to twice the size of that on the right. It was not infiltrated at all with hæmorrhage, and the left testicle appeared quite normal on surface and section.]

The Retro-peritoneal Glands—On both sides were enlarged, hæmorrhagic throughout, larger on the left than on the right, but in places spreading completely round the aorta and vena cava inferior. This latter in many places where the glands were in contact shewed the result of direct bloody extravasation through all its coats into the intima, where, on opening the vein, large, irregular, blood-stained patches stood out in conspicuous relief against the pale unstained portions. Only parts of the outer coats of the aorta were infiltrated, and its intima was nowhere involved in this process.

The Mesenteric Glands—Were slightly enlarged, and all appeared hæmorrhagic both on surface and on section.

The Pelvic Glands—On the left side were in direct continuation with and similarly affected to the left iliac glands, those on the right side appeared normal.

The mediastinal, bronchial, axillary and other glands were markedly hæmorrhagic throughout, and the same condition prevailed in all the superficial glands, axillary and other. The brain and meninges, spinal cord, and bones could not be examined.

Microscopically—The spleen, heart's blood, left inguinal, and other glands contained crowds of plague bacilli. I am indebted to my Hospital Assistant, Mr. Hari Khandu, for his notes on the case and for help in the *post-mortem* examination.

APPENDIX No. XVIII.

PAPERS RELATING TO THE PLAGUE IN THE

HYDERABAD STATE,

WITH NOTES OF THE EXPERIMENTS CARRIED OUT THERE.

From SURGEON-LIEUTENANT-COLONEL E. LAWRIE, M.B., Plague Commissioner, Hyderabad, to MAHOMED AZIZ MIRZA, Esq., Secretary to Government, Hyderabad, No. 791, dated Gunjoti, the 8th March 1898.

I have the honour to report that I have completed my tour in the Gunjoti district, and am proceeding to Naldrug on the 10th instant to inspect the infected villages in the Nizam's territory in the neighbourhood of Sholapur. The following statement will show His Highness's Government what has been undertaken in order to stamp out the infection of plague in this area.

2. I was accompanied on my tour by Mr. J. B. Buchanan, the Chief Engineer to H. H. the Nizam's Government, without whose personal assistance it would have been difficult, if not impossible, to execute works in connection with the expeditious establishment of isolation hospitals and segregation camps. Two lady doctors left Hyderabad with us and proceeded straight to Gunjoti, where they have been employed in rendering medical aid to women of this place and of Umerghi who have suffered from plague and its effects.

3. I left Hyderabad on the 22nd of February 1898, fully impressed with the belief, founded upon the experience of those who were engaged in the Hongkong epidemics of plague, that the infection of this disease is to be found principally in the floors and walls of houses, and that it can be effectually destroyed by fire; and I may remind the Government that in dealing with imported cases of plague during the last few months at Wadi, Shahabad, Gulburga, Murtoor, and in villages in the vicinity of Ahmednagar, this belief was, as far as can be judged, successfully acted upon. The result of my tour has been to prove that it is well founded, and it is now established on a more permanent or scientific basis.

4. I arrived at Homnabad on the 23rd of February 1898, and was met there by Dr. Naidu, whose patrol parties had searched all the villages on and near the road from Hyderabad to Homnabad without encountering any cases of plague. From Homnabad I proceeded to Kalliani, which important centre was found to be free from plague, and from there to Sirsi, where the first cases of the disease were seen—33 deaths having taken place. From Sirsi I came on to Gunjoti, and from Gunjoti I have visited, in company with Mr. Stevens, all the villages now plague-stricken in this area, *viz.*, Umerghi, Terrori, Kajouri, Maraj, Bulsoor and Nagaral. I may here state that in all the infected villages the orders of the Government of India, with regard to evacuation as well as the most perfect organisation for carrying out the Government rules for disinfection, had been completed before my arrival by Mr. A. H. Stevens—in such a manner that nothing remained to be done but to determine and execute a uniform plan for the destruction of the plague infection.

5. The general conclusions at which I have arrived from my inspection of the infected villages are, first, that the infection is excessively and in the most complex manner widespread; and secondly, that the area round Gunjoti and Umerghi constitutes by far the most important focus of infection in His Highness's Dominions, seeing that it directly threatens Hyderabad and Gulburga. Consequently, Mr. Stevens was well advised to make this area his main point of attack in commencing the plague operations ordered by the Nizam's Government. In this area there are known to have been 550 deaths from plague, in the villages named in the margin, since the epidemic was first reported; but Mr. Stevens and Mr. Jamshedji, the Nawab Sir Khurshed Jah's Talukdar, have no doubt that this number is from 250 to 400 short of the actual number of deaths that have taken place, since the records for the first month or two are unreliable. The localisation of the infection in the different villages was complicated by the facts that for many weeks after plague began in the epidemic form the villagers concealed its existence as much as possible, and they do not even now in many cases know which houses are infected and which are not. Moreover, they unintentionally helped to spread the infection far and wide in each village by carrying their plague sick about from one house to another on short visits among their friends and relations. Many houses were undoubtedly infected in this way besides those which were numbered and marked "infected" because people had been taken ill or had died in them.

Villages.	Deaths.
Gunjoti	233
Umerghi	172
Terrori	14
Chincholy	1
Bulsoor	42
Sirsi	41
Maraj	16
Nagaral	3
Others	12
TOTAL	550

6. During our inspections of the villages the following points claimed special attention:—

(1) The disease itself and its treatment.
(2) The infection and its localisation.
(3) The employment of fire as a disinfectant.

I.—The disease itself and its treatment.

7. The impression created in my mind by the cases I have seen is that plague must be produced by inoculation with some putrid organic (probably animal) poison. The only disease I have seen which resembles it, and the resemblance is not complete, is the blood poisoning caused by what are called "dissection wounds." Clinically * plague is not a disease in which infection would be expected to take place through air or water; and on the other hand it is just the kind of disease in which poison might be looked for in the discharges or exudations from the buboes, either on the surface or in the interior of the body. Many of the plague cases which I inspected had superficial suppurating buboes. The discharges from these suppurating buboes directly infect clothes, beds, bedding, and the floors of houses. Many other cases, again, had no superficial buboes, but these patients had in all probability buboes in the glands in the interior of the thorax or abdomen. From cases of this kind, where the lungs or intestines are implicated, certain excretions, such as the sputum or the intestinal discharges, become contaminated, and infect the clothes, bedding, beds, and the floors of houses. There is very little to add regarding the treatment of plague. I tried several drugs which might reasonably be expected to benefit the disease: nothing, so far as my limited experience goes, did any of the patients any good whatsoever.

II.—The infection and its localisation.

8. The bacillus of plague indicates the presence of the virus or infection of the disease, and practically the term bacillus is synonymous with the terms virus and infection. It is an oval-shaped micro-organism which is found in the glands and in the blood in plague, and it occurs (*a*) singly, (*b*) in pairs, and (*c*) in chains—the bacillus, the diplo-bacillus, and the strepto-bacillus.

† (*a*) The bacillus. (*b*) The diplo-bacillus. (*c*) The strepto-bacillus.

It takes stains readily and then becomes coloured like the diagram, the stain used in the diagram being the same as that employed in our examinations, *viz.*, thionin blue. Finally, it has been known since the Hongkong epidemic that plague can be produced in rats by inoculation with dust from infected houses.

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* Since writing the above, after my return from Bombay I have had a case of this kind under treatment. Hakim Cawasji was dressing a case of gangrene and inoculated himself with some of the discharge through a scratch in the ring finger of the left hand. He at once developed symptoms almost identical with plague, and had a large bubo in the left armpit and an abscess below the pectoral muscle.

† This was merely a diagram. Photo is a reproduction of a bacillus taken by Yersin. It is photographed from atlas of bacteriology not intended for publication. This photo-micrograph of the plague is in the Pasteur Institute of Paris. Lehmanre and Neumann's Hand Plate 63.

9. From the date of our arrival at Sirsi—February 25th 1898—systematic examinations of the dust and scrapings of the floors, walls, and roofs of houses in various villages have been made. The floors of all houses in the plague-stricken village are made of mud. They are for the most part the ground raised, rammed in and *leeped* over. At first only houses numbered and marked "infected" were examined: we were subsequently led by accident to examine houses which had been regarded as uninfected. In examining the dust of a supposed uninfected house, for the purpose of comparison with that of a house known to be infected, we discovered the plague bacillus in large numbers. A systematic examination of all the houses supposed to be free from infection was therefore instituted in Gunjoti, and no less than 50 per cent. of them contained the plague virus and were undoubtedly infected. At first I was inclined to think that we had possibly made a mistake in regarding the bacillus we found as the true bacillus of plague. But this was wrong. A healthy field rat was inoculated with a scraping from the ground of an *uninfected* house in which the bacillus was found, and the animal died of plague within 36 hours.* The bacillus therefore is undoubtedly the plague bacillus.

10. The following facts were established by the examinations of, and inoculations with, the plague bacillus:—

(1) The plague bacillus was invariably found in the dust and scrapings of the ground of houses known to be infected, *i.e.*, houses in which plague patients had been ill or had died. Infected houses were examined in Sirsi, Gunjoti, Umerghi, Kajuri and Bulsoor.

(2) The plague bacillus was found in the dust and scrapings from the floors of more than 50 per cent. of the houses which had previously been regarded as uninfected.

(3) A healthy rat was inoculated with dust scraped from the ground in a supposed uninfected house (No. 28, uninfected) in which the plague bacillus was found to be present. The rat died within 36 hours, and on *post-mortem* examination it exhibited the usual signs of plague, *viz.*, enlarged glands, congestions and hæmorrhages, and the plague bacillus was found in abundance in the peritoneal cavity, in the glands, and in the blood.

(4) The plague bacillus was found in grain which had been lying on the ground in an infected house.

(5) The plague bacillus was not found in the dust or scrapings of the roofs and walls of any of the houses examined.

(6) The bacillus was not found at a depth of more than an inch below the surface of the ground.

(7) The plague bacillus was found in dust taken from the floor of a house (No. 28, uninfected) immediately after the ground had been heated by igniting on it a thin layer of cowdung fuel sprinkled with kerosine oil. A rat inoculated with dust from this floor immediately after the burning, remained well until it escaped from its cage on the fourth day.

(8) In milk inoculated with dust containing the plague bacillus a growth and multiplication took place. The day after the inoculation from one to two bacilli to a field could be counted; on the fifth day from 45 to 65. In five days therefore each bacillus had increased to about 50.

(9) The plague bacillus was not found in the dug up portions of the ground (floors) after they had been burnt in the kiln method.

11. The practical value of the examinations of, and inoculations with, the plague bacillus is two-fold. In the first place they showed that the clinical conclusions in para. 5, which are by no means put forward as original, for similar conclusions were arrived at, before I saw indigenous plague at all, by Dr. H. Tripp, Lecturer on Anatomy, Hyderabad Medical School (who has been employed on plague operations for the last three months), are in the main correct. The virus of plague is most probably a putrid animal poison which falls to the ground, and does not spread through air, or even through water, unless it is excessively filthy; and it is taken into the human system mainly by inoculation. Many instances could be adduced from Mr. Stevens's experience here of sweepers who remained free from plague until they began to be employed in cleansing operations, and would appear to have become infected through the feet. In the second place, they have enabled us to determine and carry into execution a uniform plan for the destruction of the plague infection. With the help of the microscope, which after all is only a magnifying glass, the infection of plague can be traced and tracked about with as much precision as if it were visible to the naked eye. In case it is doubtful whether a given house is infected or not, an examination of the floors with the microscope settles the question at once, and very little is left to chance. On the other hand, when a house has been disinfected, an examination of the floors will show whether the disinfection has been complete or not, and it is therefore an almost infallible check on plague operations. For instance, the village of Bulsoor was beautifully clean at the time of our inspection, and Mr. Jamshedji had issued orders that the floors of the infected houses were to be dug up and burned. The village officials had dug them up, and in some cases had replaced them with earth and beaten it in. We selected two houses at random and examined the floors, and the plague bacillus was found in both. It is thus clear—and no one is more ready to acknowledge the fact than Mr. Jamshedji—that the floors of all the infected houses in the village will have to be dug up again and burnt.

III.—*The employment of fire as a disinfectant.*

12. A simple statement of what has been done since the 25th of February last will give the clearest idea of the difficulties which have been encountered in giving effect to the safe use of fire as a disinfectant. These difficulties have gradually disappeared as the localisation of the infection of plague by means of the microscope has become more precise and definite.

13. On the 25th and 26th of February the whole of the infected houses in the village of Sirsi were burned down, with the consent of the villagers who were liberally compensated. The plague bacillus was found in the floors of the houses, and this was taken as a reliable sign that the house was saturated with infection and must be destroyed. On my arrival at Gunjoti and Umerghi, I found that all the infected houses in both villages had been unroofed by Mr. Stevens's orders, and the *chuppers* had been burnt. Arrangements were then made by Mr. Stevens to apply fire to the floors and walls of all the infected houses by means of cowdung fuel and kerosine oil. While this work was progressing, we ascertained from examination of the roofs, walls, and floors of the houses, which were going on all the time, that—

(i) the infection of plague is confined to the floors of the houses;

(ii) the kerosine oil method of burning the floors is dangerous; very often the house catches fire;

(iii) some parts of the floors may escape the action of the fire or be passed over through accident or carelessness;

(iv) the kerosine oil method of burning the floors does not always generate an amount of heat which is sufficient to destroy every particle of the infection.

This plan of burning was therefore for the above reasons abandoned, and the kiln method was introduced by Mr. Stevens on the 7th instant. In this method the floors of the houses are dug up to a depth of one and-a-half inches. The dug up material is carefully removed to a short distance away from the house and made into a kiln with cowdung fuel underneath and all round it, the lower layers being sprinkled with kerosine oil: this is set fire to and allowed to burn itself out. The dug out part of the floor is thus reduced to ashes, and it is needless to say that no trace whatever of the infection of plague is left. As a precautionary measure, the lower parts of the walls of the house may be scraped, and the scrapings burned with the floors.

14. The only difficulty that remained was to know which floors to burn and which to leave alone. It is the work of some 35 minutes to find and stain the plague bacillus in one infected house, and in a village like Gunjoti there are at least 300 houses, each containing two or more rooms, besides small verandahs and courtyards. To make a microscopic search for the plague bacillus in every room of 300 houses would entail such an amount of physical labour as to be impossible. Accordingly, it has been finally decided, as the only practicable alternative to this microscopic search, that the floors of all the houses in the village are to be dealt with as infected and burnt on the kiln plan. In all the (marked) infected houses this will be done by Mr. Stevens's assistants: in all the others it will be done by the owners under their supervision. The burning will be carefully checked, and wherever it is necessary the microscope will be employed in the checking process.

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* The body was burnt.

15. Each of the villages in the Gunjoti district which has been evacuated on account of plague is now in charge of a competent medical officer, who will, it is hoped, by maintaining isolation and segregation, and by constantly changing the sites of the numerous small village encampments, succeed before long in stamping out the disease. The destruction of the infection in the villages by digging out and burning the floors in kilns will then be undertaken by Mr. Stevens's staff of assistants, who are highly trained and reliable. The officers in charge of these men are Muhammadan gentlemen whose hearts are in their work, and who thoroughly understand the objects we have in view.

16. It only remains to state in this connection that the burning of the house floors by the kiln method meets with the entire approval of Sir Khurshed Jah's Taluqdar (Mr. Jamshedji), and I may add of all the village officials and of the villagers themselves.

17. However satisfactory it may be to be able to trace out the infection of plague and to destroy it by fire, there is no disguising the fact that the Nizam's Government have a most anxious and trying time to face during the next few months. It is not merely that the value of their plague operations will only be fully tested when the villagers begin to re-occupy their houses, and it is then seen whether recrudescences of plague occur or not, but in the villages round about Gunjoti re-infection from Sholapur will have to be guarded against. The most rigid precautions will have to be maintained in the infected area until plague is stamped out in this district, and also until it has been entirely stamped out in Sholapur and in Bombay.

II.

From Lieut.-Col. E. Lawrie, M.B., Indian Medical Service, Plague Commissioner, Hyderabad, Deccan, to Mahomed Aziz Mirza, Esq., B.A., Secretary to His Highness the Nizam's Government, Judicial and General Departments, Hyderabad, No. 2156, dated Hyderabad Residency, the 12th September 1898.

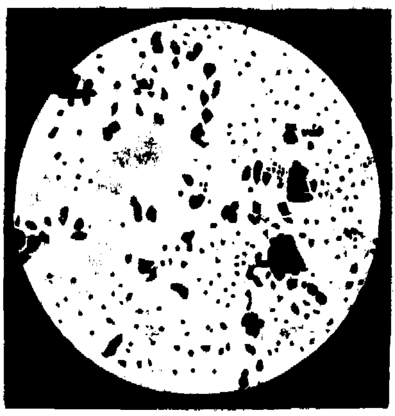
In continuation of my report, No. 791, dated March 8th, 1898, I have the honour to submit a brief record of an investigation carried out in the temporary laboratory of the Hyderabad Medical School into the bacteriology of a virus found in the floor dust and scrapings of houses infected with plague in the Dominions of His Highness the Nizam of Hyderabad. To this are appended the diary of the laboratory kept during the enquiry; a note by Surgn.-Capt. Johnston, I.M.S., and two Memoranda by Mr. Stevens on the methods of detecting the infection of plague in soil, and of destroying it by the kiln process of burning.

2. When plague operations were undertaken in the Hyderabad State, orders were issued by Government that disinfection of the floors of houses was to be performed by fire. These orders were based upon statements (*a*) of the Hongkong Plague Commissioners, Messrs. Lowson and Reade, that the infection of plague is conveyed from the sick to the healthy through the medium of floors, and (*b*) of the eminent bacteriologist, Mr. Hankin, that infection in floors is best destroyed by fire.

3. On His Highness the Nizam's Plague Commissioner assuming personal charge of plague operations in the infected districts in the Hyderabad State, a microbe closely resembling the plague microbe was discovered—first at Sirsi on the 24th February, 1898—in the surface scrapings of the floors of all the infected houses throughout the villages in which cases of plague had occurred. There was no difficulty in assuming this microbe to be the true bacillus of plague, seeing that the belief on which the Nizam's Government were acting, *viz.*, that the infection of the disease resides in the floors, was founded on clinical and experimental evidence which amounted almost to certainty. Accordingly, the infection in the shape of this microbe was tracked about by means of the microscope from house to house in the infected villages, and wherever it was found in the floors it was destroyed by fire. At first the attempt was made to destroy the infection in the floors by burning grass or cowdung, and kerosine oil on them, but this plan proved uncertain, inefficient, and dangerous—the microscope showed that some of the infection escaped destruction, and at least two accidental conflagrations ensued. Ultimately, the kiln method of burning the dug-up floors was decided upon, and this plan was rapidly brought to perfection by its originator, Mr. Stevens, who also hit upon the happy idea of thickly whitewashing beforehand all parts of the floors which it was intended to destroy. The whitewash showed exactly how much of the floor had to be dug up, and, by moistening the surface, diminished the disturbance of the infected dust, as well as the danger of infection from it to the members of the "fire brigade." The kiln process of destruction of the infection of plague proved entirely successful in arresting the spread of the disease, and it saved Government a large sum of money in disinfectants.

4. It remained to prove that the infection of plague does actually, as had been assumed, reside in floors, by demonstrating finally that the bacillus by which we had been guided in stamping out the infection in the districts is the veritable microbe of plague. Experiments on animals in Gunjoti confirmed what had been known before, *viz.*, that inoculation with the dust from floors of plague-infected houses causes death from plague; and a microbe was found in animals which had been killed in this manner, which was identical with the microbe found in the floor scrapings with which they had been inoculated. It was impossible to carry the investigation further in the districts, or to grow the plague microbe in pure cultivation; but during the month of May, 1898, a room in the Medical School at Hyderabad was fitted up as a temporary bacteriological laboratory, and on the 1st of June an exhaustive research into the bacteriology of plague-infection in the soil and in the body was commenced.

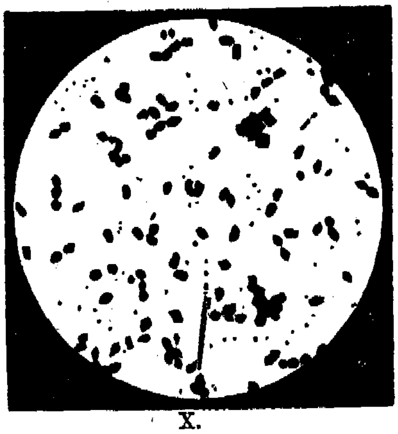
5. The first portion of the enquiry was directed to prove that the microbe found in the surface of the floors of houses infected with plague is the true plague bacillus. After a few preliminary cultivations of the microbe in broth and agar, the investigation proper was commenced by Mr. Stevens and Dr. Mullannah on the 15th of June, 1898, by the inoculation of a healthy rabbit, No. 1, with a solution of floor earth from a suspicious house in the town of Alland in the Minister's jagir, on the outskirts of the plague-infected area in the district of Naldrug. In this earth a bacillus, which closely resembled the plague bacillus, had been discovered. Plate I is a photo-micrograph of the bacillus taken from a specimen of floor earth from a suspected house in Alland on the 25th of May, 1898, by Mr. Stevens. Plate X is a photo-micrograph of the same bacillus, also taken from a preparation by Mr. Stevens on the 13th of August, 1898, from a sample of floor scrapings in an infected house in Akola near Sholapore. Plate X*b* is a photo-micrograph of a preparation of floor scrapings, from a wooden floor, made by Mr. Stevens in Bombay (No. 60, Hamal Street, Colaba) on the 8th September, 1898.



I.

Fresh preparation of plague bacilli found in scrapings from the floor of a suspected house at Alland. (× 950.)

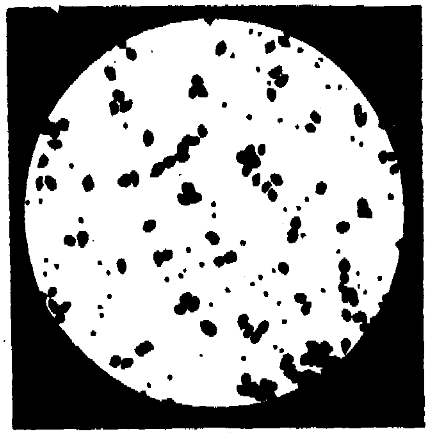
Prepared by Mr. Stevens.



X.

Fresh specimen of the plague bacillus found in the floor scrapings of an infected house at Akola. (×1,200.)

Prepared by Mr. Stevens.

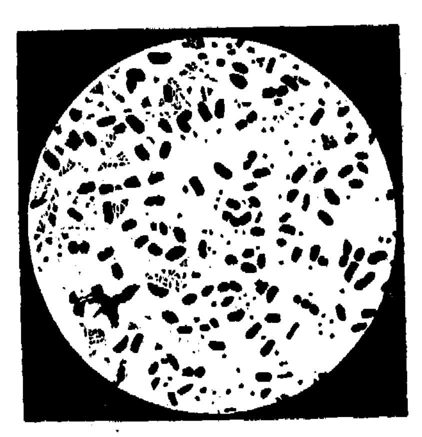


X*b*.

The plague microbe found in the wooden floor of No. 60 Hamal Street, Bombay. (×1,200.)

Prepared by Mr. Stevens.

These three photo-micrographs may advantageously be compared with Plate IX, which is a photo-micrograph of a standard specimen of the plague bacillus from the Pasteur Institute in Paris.



IX.

A fresh preparation of bacilli in the peritoneal fluid of a mouse that died of plague in the Pasteur Institute, Paris. (×1,200.)

Prepared by Mr. Mullannah.

6. The rabbit inoculated from the floor scrapings from Alland died of plague in twenty-four hours. Pure cultures were made from the blood and organs of this animal in broth and agar, and from the broth culture rabbit No. 2 was inoculated on the 17th of June, 1898. Rabbit No. 2 died of plague in six hours, and from its blood pure cultures were again made in broth and agar. From these cultures sub-cultures were prepared, and from the second sub-culture a third rabbit was inoculated on the 21st June and it died of plague in twenty-four hours. From the blood of this rabbit two pure cultivations were made, one in a large flask of broth and the other in agar. From the agar culture rabbit No. 4 was inoculated, and from this rabbit broth and agar cultures were again made. Rabbit No. 5 was inoculated from the former on the 2nd July, and rabbit No. 6 from the latter on the same date. From both these rabbits broth and agar cultures were prepared, and from the cultures from No. 5 mixed, rabbit No. 7 was inoculated on the 5th of July; while from the agar culture of No. 6 rabbits Nos. 9 and 10 were inoculated on the 14th of July. The broth culture made on the 22nd of June from rabbit No. 3 was kept sterilised until the 9th of July. It exhibited the stalactitic growth characteristic of the plague microbe. From this broth rabbit No. 8 was inoculated on the 9th of July. The last rabbit of the series, No. 10, died of plague on the 19th of July, 1898, and as there was at that time a great deal of ill-feeling being stirred up and fomented by *budmashes* in the city with regard to the experiments, they were brought to a close, and all the cultures and everything else containing the plague bacillus were destroyed by fire.

7. The genealogical table on the next page, which has been drawn up by Mr. Stevens, shows precisely how the rabbits were inoculated and the cultures kept up throughout the research. Besides the experiments with the plague microbe the following control experiments were made:—

CONTROL EXPERIMENTS.

(1) A rabbit was inoculated with pure broth, not containing the plague bacillus. No effect was produced.

(2) A rabbit was inoculated repeatedly with large doses of putrescent urine from a healthy person. No effect was produced.

(3) A rabbit was inoculated with a large dose of sterile pus from a liver abscess. No effect was produced.

(4) A rabbit was inoculated in the peritoneum with blood taken from a healthy fowl and allowed to putrefy.

(5) A rabbit was inoculated subcutaneously with 1 c.c. of the same blood as was employed in the last experiment, No. 4.

(6) A rabbit was inoculated with 0·5 c.c. of the same blood. The three rabbits Nos. 4, 5 and 6 died of septicæmia, the last after the genealogical table was completed.

8. The rabbits which were inoculated—originally from the dust of the suspected houses in Alland, and subsequently from culture and sub-cultures of the microbe passed in successive generations through suitable media and animals—died of plague, and the microbe itself is the true plague bacillus. The behaviour of the bacillus when cultivated in colonies, its appearance under the microscope, the numerous involution forms it assumes, and its uniform effects when inoculated in animals, even after passing through twelve generations of pure culture, stamp it as the bacillus of plague. Its effects on animals are that in every instance except those to be hereafter specified,* its inoculation causes death with the usual symptoms and *post-mortem* appearances of plague. Inoculation was invariably followed by high fever, and death in from six hours to five days. In all the animals the superficial glands were congested and hæmorrhagic, or inflamed and suppurating. In some cases the serous membranes were engorged and hæmorrhagic; in others the retro-peritoneal tissues; in others the spleen and liver; and in others the lungs. Wherever the organs appeared to be most severely affected by the poison, there the bacillus was found in the greatest numbers. In those cases where rapid blood poisoning was the principal feature, the blood was saturated with plague bacilli; in the pneumonic form the lungs; and in one very remarkable case, where there was general œdema of the subcutaneous cellular tissues, the œdematous fluid swarmed with the organism. Plates II, III, and IV are photo-micrographs of the plague microbe (*a*) in the blood, (*b*) in an agar culture from the blood, and (*c*) in the spleen, of animals in this series and there is no doubt whatever of its identity with the plague bacillus of Kitasato.

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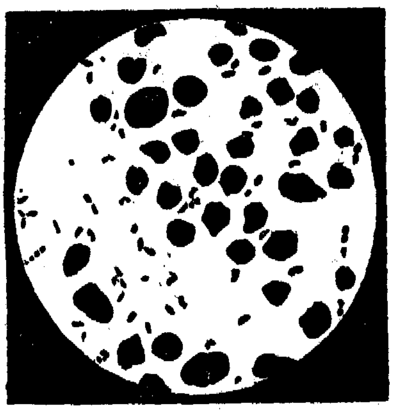
* The exceptions are:—

(*a*) Rabbits inoculated twice with very large doses, up to 32 c.c. of Haffkine's fluid.

(*b*) Rabbits vaccinated, direct from the calf, in at least six places.

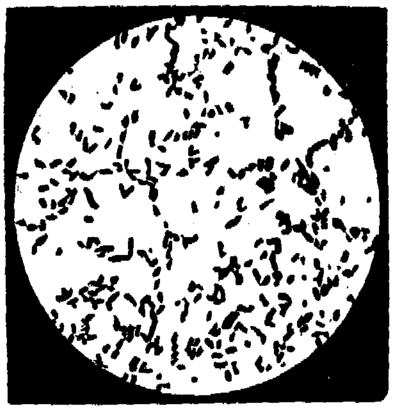
(*c*) A rabbit inoculated with a full dose of cultures and sub-cultures of the saprophytic organisms found in Haffkine's fluid, brews Nos. 1712 250.



II.

Plague bacilli in spleen of rabbit No. 9, Series 1, inoculated from a sub-culture from floor scrapings at Alland. (×550.)

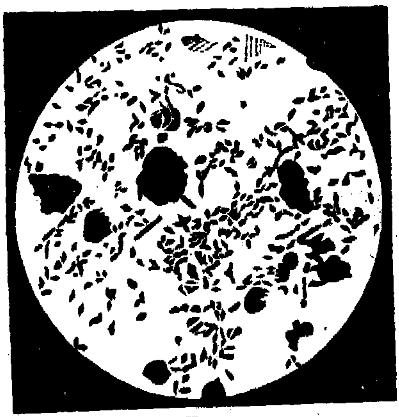
Prepared by Mr. Stevens.



III.

Fresh agar culture of five hours' growth of plague bacilli found in the blood of rabbit No. 7, Series 1, *post-mortem.* (×550.)

Prepared by Mr. Stevens.



IV.

Pure culture of plague bacilli from the spleen of rabbit No. 9, Series 1; polar-staining is well brought out by preparation of the film with alcohol. (×950.)

Prepared by Mr. Stevens.

9. The practical value of the fact that the infection of plague resides in, and spreads from the sick to the healthy through, the floors of houses is overwhelming. Before defining it there are three considerations to be glanced at. In the first place whether the infection lies dormant in the soil of which the floors of common Indian houses is composed, or whether it multiplies there is a point which is still undetermined: nor, secondly, do we know how long it retains its vitality under favourable conditions. In fresh clean earth, exposed to the air and light, the plague bacillus would die out in the course of a few hours. It is quite a different matter in houses. Even in the dust of the floor of an ordinary house the plague microbe would probably meet with sufficient pabulum to keep it alive and toxic for some time. But in made-earth or mud floors—in dark unventilated rooms—which are smeared over from time to time with liquid cowdung, and form the receptacle for all kinds of putrescent organic matter, the microbe would be sure to find an unlimited supply of the food that it likes, and on which it might thrive or multiply indefinitely.

10. In the third place it is possible that there may be other sources of infection in plague besides the floors of infected houses, for example grain or clothing, or animals such as rats—but these are practically included in infection through the floors, since they become contaminated from that source. The only exception to the latter proposition is clothing, with which must be included rags and bedding, which may be contaminated directly by discharges and excreta from the body, and in all cases requires special treatment by fire or boiling for the purpose of disinfection. But the effective infection in clothing is necessarily limited in amount, and the microbe has less to feed upon than in floor earth. Moreover, clothing is easily disinfected by burning or boiling, and it is constantly exposed to the disinfecting and purifying influences of sunlight and fresh air, which the floors of an Indian house of the poorer class rarely if ever are.

11. The practical value of the knowledge that the plague virus lodges in and is disseminated through the floors of houses is as follows:—

(1) The infection of plague can be tracked about by means of the microscope with as much certainty as if it were visible to the naked eye. Wherever the plague microbe is found, there is the virus, and there also is the food, the particular kind of filth, on which it lives.

(2) The value of disinfection can be measured by the same means. Where measures of disinfection are successful, the plague microbe entirely disappears from the disinfected floor and cannot any longer be discovered by the microscope.

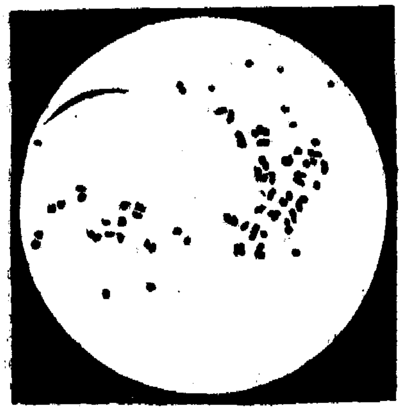
(3) The one disinfectant with which uniform results are obtained is fire. When a mud floor is reduced to ashes by the kiln process of burning, no trace of the microbe can be discovered in the ashes. No other disinfectant can be relied upon to effect such complete destruction of the plague virus, and there is none which costs so little.

(4) By means of the microscope, fire and boiling, plague can be stamped out with nearly mathematical certainty.

(5) Floors and clothing contain the food by which the plague microbe is kept alive. Their disinfection by fire and boiling destroys the food-supply of the infection, and without any of the food that the microbe likes it dies out, if it gain access to a house, without doing any harm.

12. Orders have been issued to the Deputy Plague Commissioner, Hyderabad Districts, to have the floors of all houses between the Sholapur frontier and Hyderabad burned by the kiln method. But it is obviously useless to stamp infection out in one area while other areas in India, from which it may be re-infected, remain infected, and it becomes a question whether the time has not arrived to adopt uniform measures for getting rid of plague all over India. It would be a work of vast magnitude, but one that is by no means insuperable, to destroy the floors of all houses which may harbour the plague germ from one end of India to the other. A thorough measure of this kind would carry the whole country with it, and it would probably cost, roughly, very much less than has been already spent in Bombay alone on disinfectants. In the villages the villagers are everywhere quite willing and able to carry out disinfection by fire themselves, and with their own materials, under supervision. In the disinfection by fire of a large city such as Bombay special difficulties would unquestionably be encountered, but all difficulties would have to be surmounted where so many world-wide interests of an imperial and international character are concerned.

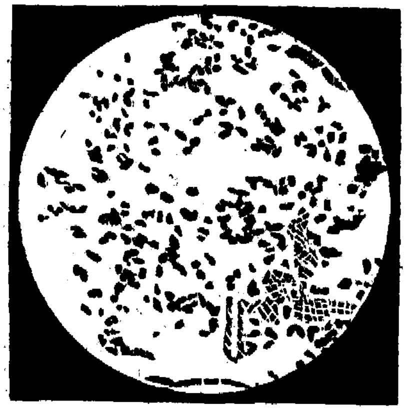
13. The photo-micrographs were taken and printed by F. Buchanan.



V.

Pure culture of plague bacilli from the gland of a patient who died of plague at Hubli. (×550.)

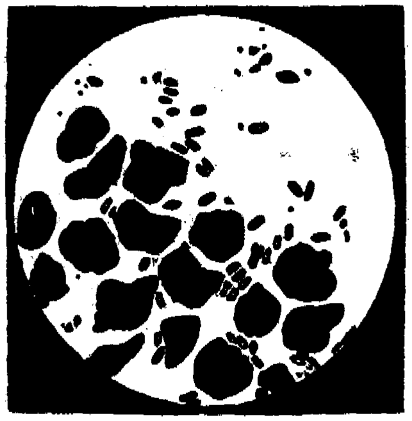
Prepared by Dr. Mullannah.



VI.

Sub-culture of plague bacilli from the gland of a case of plague at Hubli. (×550.)

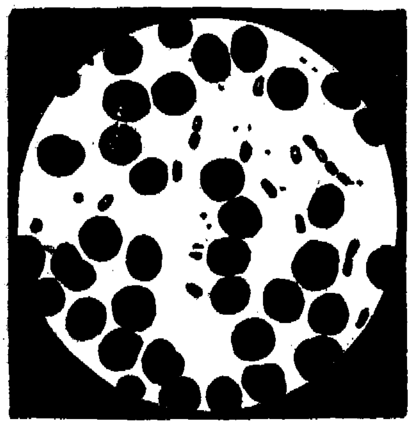
Prepared by Dr. Mullannah.



VII.

Plague bacilli from the spleen of rabbit No. 1, Series 2, inoculated from a sub-culture of bacilli found in the glands of a plague patient at Hubli. (×1200.)

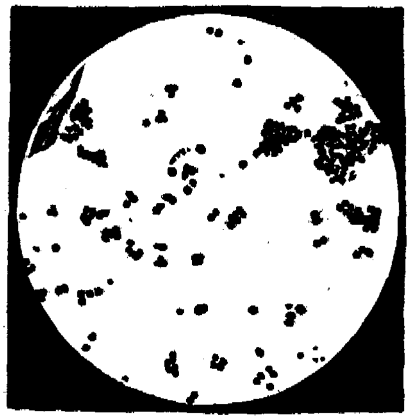
Prepared by Dr. Mullannah.



VIII.

Plague bacilli in the blood of rabbit No. 1, Series [illegible], inoculated with a sub-culture of plague glands from Hubli. (×1200.)

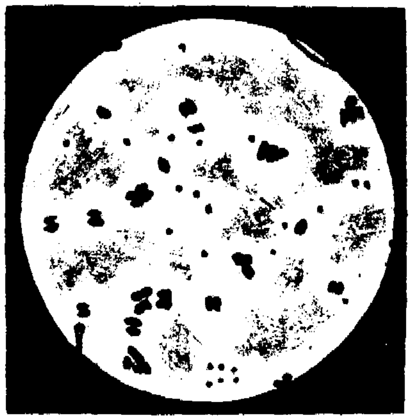
Prepared by Mr. Stevens.



XI.

Pure culture of micro-cocci from Haffkine's [illegible] No. 1713 brew. (×1200.)

Prepared by Dr. Mullannah.



XII.

Sub-culture of the organism found in fresh Haffkine's fluid, brew No. 1713. (×1200.)

Prepared by Dr. Mullannah.

III.

DIARY OF THE HYDERABAD MEDICAL SCHOOL LABORATORY.

Condensed by the Plague Commissioner from the daily reports of MR. STEVENS, *Deputy Plague Commissioner.*

June 1st, 1898.—Tubes of agar were inoculated with distilled water solutions of earth from four houses in Alland* in which bacilli, resembling in form the plague bacilli, were found, besides other organisms

June 2nd.—Cover glass preparations from the agar cultures were made and examined. Numerous mixed organisms were found in each culture. Sterilized broth was prepared.

June 3rd.—Four tubes of broth were inoculated from the four floor scrapings. It is to be noted that drops of sterilized ghee were always placed on the surface of the broth medium.

June 4th.—Cover glass preparations were made from the four inoculated tubes of broth. The cultures from Ganu chambar's house exhibited an abundance of organisms, micrococci, and a few bacilli. Three agar tubes and five plates were inoculated from the Ganu chambar's cultivation.

June 5th.—Six broth and three agar tubes were inoculated from the Ganu chambar's culture.

June 6th.—Two broth cultures were made from the cultivation (Ganu chambar's) of the preceding day.

June 7th.—A three-litre Florence flask of broth was inoculated from Ganu chambar's sub-culture.

June 10th.—A flask of broth was inoculated with scrapings from Hunia dyer's house, bacilli having still been found in its floor earth.

June 11th to 14th.—Fresh sub-cultures in broth were made of the culture from Hunia dyer's house.

June 15th.—A full-grown healthy rabbit, No. 1, was inoculated in the peritoneum at 10 A.M. with 5 c.c. of a solution of earth in sterilized water from Hunia dyer's house.

June 16th.—At 6 A.M. the inoculated rabbit was found dead. *Post-mortem* examination:—There was some extravasation of sanguineous fluid beneath the skin of the abdomen around the site of inoculation. Extravasations of blood were found in and around the glands of the mesentery and groin. A small quantity of serous fluid was found in the peritoneal cavity. Cover glass preparations from this fluid were made, and plague bacilli were found in considerable numbers. One preparation from the liver and three preparations from the blood gave similar results. No micrococci were present: the organism was pure plague. Four tubes of broth were then inoculated, two from the blood, one from the peritoneal fluid, and one from the liver.

June 17th.—Cover glass preparations were made from the previous day's culture of the peritoneal fluid with the following result:—

The surface of the culture showed a pure cultivation of plague bacilli in myriads.

As it was clear that the plague bacilli remain, in the first instance, at all events, on the surface of the medium, only the scum was taken from the blood and liver cultures, both of which exhibited a pure growth of the plague bacillus.

June 11th to 16th.—A rabbit was inoculated daily in the peritoneum with two drachms of putrid urine full of various organisms of putrefaction; the rabbit remained well; a drop of its blood was examined from day to day and nothing abnormal was found in it.

June 16th.—The scum from the broth cultivation from Ganu chambar's house, made on the 7th of June, was examined, and contained plague bacilli.

June 17th.—At 9 A.M. a full-grown healthy rabbit, No. 2, was inoculated with the broth cultivation from rabbit No. 1. This animal died at 4 P.M. the same day. Plague bacilli were found in abundance in the peritoneal fluid and in considerable numbers in the axillary glands, which were enlarged and studded with blood extravasations. No bacilli were found in the spleen, liver, or blood.

Agar plate and tubes were inoculated from the peritoneal fluid, glands, spleen, liver, and blood.

June 19th.—Almost all the cultures from rabbit No. 1 were found to contain micro-cocci.

The cultures from rabbit No. 2 (which had died six hours after inoculation with a broth culture from rabbit No. 1) gave uniform results. A few micro-cocci were found, mixed with an almost pure plague culture, in the peritoneal fluid and liver. On the other hand, the cultures from the blood and spleen consisted entirely of plague bacilli. In the preparations made on the 17th instant direct from the cadaver of rabbit No. 2, plague bacilli had been found in the peritoneal fluid and in the axillary glands, but none had been detected in the spleen, blood, or liver.

Broth and agar tubes were inoculated from the broth cultivation from the blood, spleen and liver of rabbit No. 2.

The second broth culture from Ganu chambar's floor earth contained plague bacilli and micro-cocci mixed.

Tubes of broth were inoculated from the second culture of Ganu chambar's house.

Agar plague cultures.

June 21st and 22nd.—The second culture from the blood and spleen of rabbit No. 2—which died after inoculation from a culture from the blood of rabbit No. 1—exhibited colonies of oval-shaped and small, occasionally polar-stained, bacilli.

Broth cultures.

On microscopic examination the scum was composed of a pure culture of small plague bacilli, agreeing precisely in appearance with the illustration of plague bacilli on page 253 of Crookshank's text-book of bacteriology. A few large oval bacilli were found at the bottom of the broth cultures, some of the former polar-stained.

Dr. Burrows commenced to make coloured drawings of the various preparations already made.

A full-grown healthy rabbit, No. 3, was inoculated at 6 P.M. on the 21st instant with broth sub-culture two days' old of rabbit No. 2, and was found dead on opening the laboratory at 7 A.M. on the 22nd.

On examination, the glands and blood of the cadaver contained oval and rod-shaped bacilli. Cultures were prepared from the blood and glands.

June 23rd.—The various cultures were examined. Those made on the 16th June, from blood of the first rabbit inoculated with a sterilized watery solution of floor earth from Hunia dyer's house, contained a pure growth of bacilli exactly similar to those met with in the original floor earth preparations. Tubes of broth and agar were inoculated from this culture. A full-grown healthy rabbit was inoculated with the putrescent blood of a healthy fowl.

June 25th.—On opening the laboratory the rabbit inoculated with putrid blood was found dead. Blood was issuing from both nostrils, the eyes were much distended, and the glands were swollen. Upon examination, bacilli and other organisms were found in the blood, spleen, liver, glands, etc. The majority of the bacilli found were thick, rounded rods, similar in appearance to the bacilli found in the putrid blood before it was inoculated into the rabbit.

Tubes of broth and agar were inoculated from the blood etc., of the above rabbit.

June 26th.—The cultures from the above rabbit were examined and found to contain thick rod bacilli and other mixed saprophytic organisms.

Cover glass preparations were made from the tubes inoculated with the seven days' old culture (inoculated on the 23rd) from Hunia dyer's floor earth, with the following results:—

(*a*) The growth of the cultures in agar in the greater part of the tube was characteristic of the plague bacillus; and upon individual colonies being carefully removed and examined they were found to contain a pure culture of barrel-shaped plague bacilli which exhibited polar-staining. Several cover glass preparations were made, and fresh tubes were inoculated from the characteristic plague colonies.

(*b*) The growth of the cultures in broth exhibited a slight scum at the top with a deposit on the sides and bottom of the tube. The deposit was examined and found to contain a pure-growth—a predominance of polar-staining plague bacilli mixed with a few oval forms.

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* The two houses in Alland from floor scrapings of which pure cultivations of plague microbes were obtained, were:—
Ganu, the leather-worker (chamar): and
Hunia, the dyer (a dher by caste).

(It was subsequently discovered, on further staining of fresh preparations, that these rounded forms were possibly bacilli seen end on.)

A full-grown healthy rabbit, No. 4, was inoculated direct from the above pure agar tube culture, and fresh tubes of soup and agar were inoculated at the same time. One large Florence flask of soup was also inoculated.

June 27th.—The temperature of rabbit No. 4, inoculated on the 26th instant with a small dose of plague culture, was 104·6° at 7 A.M., on the 27th: a healthy rabbit's temperature taken at the same time was 101°. At 5-30 P.M. the inoculated rabbit's temperature was 105·2°, the uninoculated rabbit's was 102°. At 7 A.M. to-day the inoculated rabbit's temperature was 106·2°, and that of the uninoculated rabbit was 102°.

Several preparations were made from the plague cultures in broth and agar which were made on the 26th instant. All gave uniform results. They consisted of a pure culture of plague bacilli (barrel-shaped) with a few oval forms. Fresh tubes of broth and agar were inoculated.

The cultures from the blood and spleen of the rabbit that died after inoculation with putrid blood were examined. The results were uniform, and exhibited a large number of bacilli somewhat similar in appearance to the barrel-shaped plague bacilli, as well as long pipe-shaped bacilli with round ends, and micro-cocci. A hanging-drop preparation of the putrid-blood culture showed that all the bacilli were motile. A hanging-drop preparation of plague culture was examined, and the plague bacilli, except for a faint undulation, were thought to be stationary and non-motile.

June 28th.—The temperature of rabbit No. 4, inoculated with plague culture on the 26th, was 105·2° at 6 A.M. and 106·4° at 6 P.M. Sterile broth and agar plates and tubes were prepared. Preparations made from the various cultures were examined, and contained pure plague bacilli. Fresh media were inoculated.

Impression preparations were made of individual colonies of plague bacilli from agar culture.

June 29th.—At 6 A.M. the inoculated rabbit No. 4 was found dead. On *post-mortem* examination the axillary glands were enlarged and contained blood extravasations.

Microscope examination of the blood and spleen:—Plague bacilli were found in both unassociated with any other bacilli or micro-cocci.

No organisms were found in the glands, liver, or peritoneal fluid. Three cover glass preparations of each were made.

Broth and agar tubes and plates were inoculated from the blood, spleen, liver, glands, and peritoneal fluid.

In a large Florence flask of broth inoculated four days ago with plague culture, an indication was noticed of stalactitic growth.

Cover glass preparations from the various cultures were made, and gave uniform results: they consisted of pure plague culture. Impression preparations of colonies, also, were made. Some of the plague bacilli were rounded in form, and answered to the test with Gram's solution.

One very perfect preparation was made by Captain Johnston, I.M.S., in which all the bacilli were polar-stained, the barrel-shaped and oval plague bacilli appearing together in almost every field.

June 30th.—A full-grown healthy rabbit was inoculated in the peritoneum with four drachms of sterile pus from a liver abscess. (This rabbit was not affected by the inoculation.)

July 1st.—The cultures in agar of the blood, spleen, liver, glands, and peritoneal fluid of the rabbit No. 4 were examined. The growth was charateristic of the plague bacillus, but not very vigorous.

The cultures in broth of the blood and peritoneal fluid of rabbit No. 4 were examined, and preparations were made, which exhibited a pure growth of plague bacilli, some of the forms being pipe-shaped and slender. Chains of from four to nine bacilli, which were polar-stained, were abundant.

July 2nd.—Broth and agar cultures were examined and preparations made for testing purposes. The broth culture from the blood of rabbit No. 4 in a large Florence flask exhibited the well-known stalactitic growth characteristic of the plague bacillus. At 6 P.M. two full-grown healthy rabbits were inoculated as follows:—Rabbit No. 5 with a broth culture from the blood of rabbit No. 4; rabbit No. 6 with an agar culture in sterilized broth from the blood of rabbit No. 4.

July 3rd.—At 6 A.M. rabbit No. 5 was found dead, and rabbit No. 6 was moribund: it died at 6-30.

The *post-mortem* examinations were as follows:—

Rabbit No. 5.

Superficial glands injected, studded with blood extravasations, and swollen; bladder fully distended; a scanty amount of serum in the peritoneum; pericardium injected; heart injected; left side empty and contracted; right side distended and injected; lungs highly injected; spleen injected but not enlarged; liver injected; gall bladder full; all the glands and all the viscera, except the stomach and the small intestines, are deeply injected.

Rabbit No. 6.

External appearances.—The body in a state of rigor mortis; abdomen swollen; superficial lymphatic glands in left groin swollen. The deep lymphatic glands in the right groin are very much enlarged and contain blood clots. Axillary glands on the right and left sides both superficial and deep enlarged. Heart distended and engorged, with superficial congestion, and right ventricle enormously so; lungs intensely congested; liver congested; spleen congested but normal in size; peritoneum contains a small amount of serum.

Cover glass preparations from the blood, glands, spleen, liver, lungs and peritoneal fluid of both rabbits, Nos. 5 and 6, were made, and examined under the microscope with the following results:—

Rabbit No. 5.

A few plague bacilli were found in the lungs and blood. Agar and broth were inoculated from all the organs and parts examined.

Rabbit No. 6.

Plague bacilli were found in large numbers in the blood, spleen, glands, liver, lungs, and peritoneal fluid. Agar and broth were inoculated from all the parts examined.

Colonel Little and Captain Johnston, I.M.S., were present in the laboratory throughout the day.

July 4th.—The broth and agar cultures were examined, and a vigorous growth was found in all of those made on the preceding day from rabbits Nos. 5 and 6. One very fine agar tube culture from the blood of rabbit No. 4 was photographed.

The broth culture of plague in the large Florence flask exhibited the characteristic stalactitic growth. The broth is quite clear with an increasing sediment. Ten cover glass preparations were made from the broth and agar inoculated twenty-four hours previously from the blood, spleen, and glands of the rabbits Nos. 5 and 6. The preparations were stained with fuchsin, gentian violet, and methylene blue, and all were found to be pure plague cultures. Many of the plague bacilli polar-stained. The agar cultures exhibited swarms of bacilli rather small in size, with a few long, curved involution forms. The broth cultures, although containing a less vigorous growth and fewer bacilli than the agar cultures, exhibited plague bacilli truer in shape, larger in size, and in chains of from two to five bacilli.

Sub-cultures were made by inoculating fresh tubes of broth from the original cultures.

A very large rabbit, No. 7, was inoculated with a small dose of 20 minims of broth culture four days old from rabbit No. 5 at 10 A.M. Its temperature then was 102°: by 6 P.M. it had risen to 104°.

A photograph was taken of a characteristic field of plague bacilli from a twenty-four hours' culture from the blood of rabbit No. 6.

July 5th and 6th.—The rabbit inoculated on the 5th was again inoculated on the evening of the 6th. Its temperature was 104·2° on the 5th, 105·4° on the 6th, and 106·2° on the 7th, when it died at 8-30 A.M. A *post-mortem* examination was made at 10 A.M. in the presence of Captain Johnston, I.M.S. Lymphatic glands were found swollen with hæmorrhages and injected.

Gland, liver, blood, lungs, spleen, and peritoneal fluid preparations were made and examined under the microscope. Plague bacilli were found in all; they were abundant in the peritoneal fluid, fairly numerous in the liver, both on the surface and in the substance of the organ, and in smaller numbers in the other preparations. No micro-cocci or other organisms were found.

Tubes of agar and broth were inoculated from the blood, spleen, glands, etc. The cadaver was burnt to ashes, and the usual precautions taken for thoroughly sterilizing, in the hot chamber and by steam pressure, all instruments, tubes, clothes, etc., used in the *post-mortem* examination; the table and floor being drenched with perchloride of mercury solution as usual.

Examinations were made of all recent cultures, and all were found to be absolutely pure plague cultures, without any admixture of micro-cocci or other bacilli. Cover glass preparations were made and stained with gentian violet methylene blue, and fuchsin. Some photographs were also taken.

In some of the older cultures many involution forms are to be found. Agar is found to suit the plague bacillus better than broth; it appears to like it better, the growth being more vigorous in the former than in the latter. In agar cultures after the fifth day the bacilli became smaller and more oval in shape.

July 9th.—A full-grown healthy rabbit was inoculated at 10 A.M. with 20 minims of sterilized broth, and a second rabbit, No. 8 of the plague series, was inoculated with 20 minims of the broth from the large Florence flask containing a plague culture fourteen days' old. Both inoculations were made subcutaneously on the wall of the abdomen.

At 6 P.M. the temperature of the sterilized broth rabbit was normal, that of rabbit No. 8 was 105°. At 9 A.M. on the 10th July the temperature of the former was normal, that of rabbit No. 8 was 105°. Some ordinary floor earth from a cooly's hut was inoculated with a plague culture in broth.

July 10th.—The tubes of agar inoculated on the 8th July from the Florence flask culture (fourteen days' growth) were examined, and all exhibited a most vigorous growth. Preparations were made with the following results:—The first preparation contained a dense growth of bacilli of the oval form, clustered together in patches, not unlike fish spawn, a few single rod bacilli being scattered here and there between the patches. The second preparation exhibited long leptothrix forms, a few short chains of three or four rod bacilli, and some dumb-bell shaped bacilli were found in some fields. The third preparation was composed entirely of rod-shaped bacilli, all well shaped, singly, in pairs, and in chains—some consisting of seven and eight bacilli. No circular or involution forms were present. The preparations have been carefully numbered and preserved, as it is intended to photograph them as a series, in order to demonstrate the very diverse forms the plague bacillus assumes when cultivated. Captain Johnston subsequently made a preparation from the same tube in which all three forms occurred together. Fresh sub-cultures in broth and agar were made. The blood and spleen cultures in agar from the rabbit No. 7 were examined. It will be remembered that these cultures after twenty-four hours' growth exhibited dense patches of small oval-shaped bacilli. After four days this growth had developed into the characteristic rod-shaped form of the plague bacillus. Oval forms were conspicuous by their absence. Sub-cultures in agar and broth were made.

Several microscopic preparations were made from sub-cultures of forty-eight hours' growth in agar from the blood and spleen of the rabbits Nos. 4 and 5. A most vigorous growth was found, many of the bacilli being barrel-shaped and a large number polar-stained; in some specimens groups of the oval-shaped bacilli of small size occurred.

Blood taken from the living rabbit, No. 8, inoculated on the 9th with plague culture contained a few rod-shaped bacilli.

The seat of the inoculation on the abdomen of the rabbit was somewhat swollen; serum was drawn off and contained plague bacilli.

An agar tube was inoculated from the blood of the sick rabbit No. 8.

The inoculated floor earth was examined, and was found to contain bacilli.

July 11th.—A standard peptone solution (Warden's) was prepared, as well as broth and agar tubes. All were sterilized and kept ready for future use.

The temperature of rabbit No. 8, inoculated with a plague culture on the 9th July at 11-30 A.M., was 106°.

July 12th.—The temperature of the inoculated rabbit, No. 8, was 107°, and it died at 11-30 A.M., *i.e.*, 72 hours after inoculation. A *post-mortem* examination was held at 2-10 P.M., Captain Johnston, I.M.S., being present.

External appearances.

The body is in a state of rigor mortis, extensive extravasation in the skin at the seat of inoculation, both testicles are enlarged, the axillary glands are enlarged and contain blood clots.

Internal appearances.

General infiltration of the subcutaneous tissues. In the axilla there are chains of enlarged glands. The glands in the groin are enormously enlarged with extravasations of blood, and highly injected.

Left side of the heart contracted, and the right side slightly distended. The spleen is enlarged, and small foci of suppuration are present. The liver is enlarged and friable. The lungs are normal in appearance. The mesenteric glands are greatly enlarged. This rabbit exhibited marked signs of bubonic plague.

Preparations were made, stained and examined with the following results:—Plague bacilli were found in swarms in the blood and in considerable numbers in the spleen and lymphatic glands.

Bacilli were not found in the peritoneal fluid, liver, lungs or testes.

In the mesenteric glands the bacilli were long, somewhat thin and pointed at both ends; polar-stained bacilli appeared in every field.

The bacilli found in the blood and spleen were of the same size and appearance as the plague bacilli found in the other rabbits.

Broth and agar tubes were inoculated from the blood, spleen, glands, peritoneal fluid, and testes.

The cadaver was burnt to ashes, the tables and floor washed with perchloride of mercury solution, and all the instruments, etc., used in the *post-mortem* examination sterilized by boiling under steam pressure in the steam sterilizer. The rabbit, No. 7, that was inoculated with sterilized broth at the same time as rabbit No. 8, as a control experiment, is in perfect health with a normal temperature.

Up to date there are 72 slide preparations, showing the results of the various experiments, commencing from the preparations of the infected floor earth in the village of Alland, dated the 28th May, up to the examination of rabbit No. 8. Besides this, we have a complete set of preparations of floor earth from every infected village in the Gunjoti circle.

From the above 72 slides, 35 drawings in water-colour have been made from the microscope, besides photographs.

July 13th.—A general clean-up of the laboratory took place, the floor and all the tables were well drenched and washed with perchloride of mercury solution. All old cultures were sterilized in the steam pressure sterilizer, mixed with perchloride of mercury solution, and boiled.

July 14th.—All recent cultures were examined and preparations made. As the broth cultures exhibited such a poor growth, they were sterilized and destroyed, and agar cultures only were kept.

At 4-30 P.M. a healthy rabbit, No. 9, was subcutaneously injected with 0·5 c.c. of agar plague culture in sterilized broth, and a second rabbit, No. 10, with 3 c.c. of the same culture.

July 15th.—The blood of the two living rabbits, Nos. 9 and 10, was examined twenty-four, hours after inoculation. Bacilli were found in the blood. After thirty-six hours larger numbers of bacilli were found in the blood of both rabbits, and cover glass preparations were made and photographed.

As a control experiment a rabbit was inoculated with 0·5 c.c. of putrescent blood, and another with 3 c.c., both subcutaneously.

July 16th.—At 12 noon rabbit, No. 9, died, and a *post-mortem* examination was held at 4 P.M.

External appearances.

There was infiltration at the seat of inoculation. The right axillary and inguinal glands were enlarged and contained extravasated blood; the left axillary and inguinal glands were not enlarged. Deep injection of right inguinal region. The right side of the heart distended; left side empty and contracted; the superficial vessels were highly injected.

Tubes of agar were inoculated from the heart's blood, gland, spleen, liver, and peritoneal fluid.

Slides were prepared and examined with the following results:—

In the glands, spleen, and liver there was a pure growth of the plague bacillus. Myriads of oval and sausage-shaped bacilli appeared in every field, many of them polar-stained.

The blood and peritoneal fluid exhibited a few bacilli here and there. No bacilli were found in the lungs. The bacilli in the glands, spleen and liver exactly correspond in appearance with the bacilli in the standard slide prepared at the Pasteur Institute, Paris, of the blood of a mouse inoculated with plague bacilli. Photomicrographs of both the Paris slide and the various preparations of the rabbits, Nos. 8 and 9, were taken for comparison.

Rabbit No. 10 is alive, temperature 107°.

The two rabbits inoculated with putrid blood are both alive; the temperature of one is 105°, the other 106°. The one injected with 3 c.c. appears to be very ill.

July 17th.—Colonel Little and Captain Johnston, I.M.S., attended the laboratory.

The cultures and preparations were examined and fresh preparations made.

Rabbit No. 10, and the two rabbits inoculated with putrid blood, are all alive.

July 18th.—The rabbit inoculated with 3 c.c. of putrid blood died at 11-30 A.M. to-day. The *post-mortem* examination was held at 4 P.M., and general signs of septicæmia were observed. Microscopic examination showed a few organisms in the spleen, glands, and blood. (The rabbit inoculated with 0·5 c.c. of putrid blood died of septicæmia on the 19th instant.)

Rabbit, No. 10, died at 4-30 P.M., and the *post-mortem* examination was made at 5 P.M., with the following results: glands in the right axilla very much enlarged and fused together, exhibiting blood extravasations and a few foci of suppuration.

Spleen much enlarged and suppurating in a few spots, which were only seen on section of the organ. Left side of the heart is contracted and empty. Right side distended. The left auricular appendix is distended. Microscopic examination showed no organisms in the blood; but plague bacilli were present in the glands and spleen.

Conclusion.—All the plague cultures have been destroyed by boiling, and this set of experiments has thus been brought to a conclusion.

The corrected genealogical table of the plague cultures, thirty-five generations and six control experiments, is appended.

IV.

HYDERABAD MEDICAL SCHOOL LABORATORY.

Note by CAPTAIN JOHNSTON, *M.B., D.P.H., Indian Medical Service, dated Boanpili, the 5th August 1898.*

Experimental investigations were undertaken by the Plague Commissioner in the Hyderabad Medical School Laboratory and had reached a somewhat advanced stage when I visited the school for the first time on June 26th.

Previous to this, the investigations were undertaken in order to discover whether any living plague organisms were present in the floor earth of certain suspected houses in which plague patients were known to have died.

The method followed was, *first*, by means of inoculating artificial sterilized media, *e.g.*, broth and agar, with solutions of earth in distilled water and by the earth itself, and examining the cultures which were the result of this inoculation; *secondly*, making sub-cultures of colonies which were identical in appearance with plague; and, *lastly*, inoculating healthy rabbits with the culture and sub-culture growths. As a result of the investigation so far, it was found that the floor earth from the houses of Hunia dyer and Ganu chambar contained the plague bacillus.

On June 26th from sub-cultures of an agar culture of Hunia dyer's floor earth, colonies, which were in our opinion identical with plague colonies, were picked out from the mixed growth of the sub-culture agar tubes and were inoculated into fresh agar tubes in order to procure a pure growth of plague. These freshly inoculated agar tubes were subsequently examined microscopically by cover glass preparations (stained, unstained, and hanging drop) and were found to contain colonies morphologically identical in all respects with those of the plague bacillus.

Healthy rabbits were inoculated with this growth of agar culture, with the result that they went through an illness, chiefly characterised by high fever, and finally died in from 36 to 72 hours. On *post-mortem* examination of the rabbits, signs denoting a disease similar to that seen in necropsies of plague were found, and bacteriological examination of the blood and glands showed a bacillus morphologically identical with the plague bacillus. Inoculations in an artificial sterilized media were made from the blood, peritoneal fluid, and glands of these animals, the resulting cultures of which showed uniform colonies whose bacilli were identical with the plague bacillus in all points. The bacilli found in the cultures after being passed through the rabbit were identically the same, in all respects, with the bacilli found in the culture growths with which the rabbit was inoculated, and no other bacilli beyond this one form were found.

From the last cultures a series of rabbits was inoculated with a similar series of experiments, all giving uniform results as regards the bacteria found in the blood and glands of the rabbits.

Control experiments were made on similar healthy rabbits with the following inoculations:—

(*a*) Sterilized broth (result, no death).

(*b*) Putrid urine (putridity caused by exposure to air) (result, no death).

(*c*) Putrid blood (result, death in every instance).

In the case of control experiments with the putrid blood, the bacteria found in the putrid blood and in the blood of inoculated rabbits were identical with one another, but differed from the bacillus obtained from the floor of Hunia dyer's house, and retained the stain when treated by Gram's method.

Koch's canons having been fulfilled as regards the transmission through rabbits, and development in artificial media outside the body, of the bacillus separated from the suspected floor earth—and giving results similar in all respects to the properties, actions, and history of the microbe described by Kitasato as the typical plague bacillus—the irresistible conclusion is that living plague organisms were present in the floor earth of the suspected houses, and that the patients in those houses died, as was stated, of plague.

Among other points elicited during these investigations the following was prominent, *viz.*, the plague bacillus is a very sensitive organism as regards its staining properties; it very readily takes up stains and just as readily gives them up; the stained preparations mounted in xylol balsam or cedar oil and clove oil sometimes do not keep stained longer than a few days; Canada balsam alone allows them invariably to retain the stains longer.

V.

EXPERIMENTS IN THE TEMPORARY LABORATORY, HYDERABAD MEDICAL SCHOOL.

SERIES I.

Rabbit No. 1.—Inoculation experiment with scrapings from the floor of an infected house. No. 1 was inoculated with 5 c.c. of a watery solution of scrapings taken from the floor of the house of Hunia dyer, at 10 o'clock A.M. on the 15th of June, 1898. Died of plague on the 16th of June.

Rabbit No. 2.—Control experiment. No. 2 was inoculated in the peritoneum with drachm-doses of putrid urine on the 11th, 14th, 15th, and 16th of June, 1898, and remained well.

Rabbit No. 3.—Inoculation experiment with a plague culture. No. 3 was inoculated on the 17th of June, 1898, with 1 c.c. of a broth culture from the blood of No. 1. Died in six hours, of plague.

Rabbit No. 4.—Inoculation experiment with a sub-culture of the plague microbe. No. 4 was inoculated on the 21st of June, 1898, with two of the third sub-cultures, mixed, from the blood of No. 2. Died in 10 hours, of plague.

Rabbit No. 5.—Control experiment, inoculation with putrid blood. No. 5 was inoculated with 1 c.c. of putrid blood from a healthy fowl. Died of septicæmia, on the 25th of June, 1898.

Rabbit No. 6.—Inoculation experiment with a culture of the plague microbe. No. 6 was inoculated on the 26th June, 1898, with 1 c. c. of an agar culture liquefied from the blood of No. 4. Died on the 29th of June, of plague.

Rabbit No. 7.—Control experiment. No. 7 was inoculated in the peritoneum with two drachms of sterile pus from a liver abscess on the 30th of June, 1898, and remained well.

Rabbits Nos. 8 and 9.—Inoculation experiments with plague cultures. Nos. 8 and 9 were inoculated with 1 c.c. of plague cultures in broth and agar from the blood of rabbit No. 6 on the 2nd of July, 1898. Both died of plague on the 3rd of July, 1898.

Rabbit No. 10.—Inoculation experiment with plague culture. No. 10 was inoculated on the 5th of July, 1898, with 1 c.c of a pure culture of the plague bacillus from the blood of No. 8. Died on the 7th of July, of plague.

Rabbit No. 11.—Control experiment. No. 11 was inoculated with one drachm of the sterile broth employed for the pure cultures. Remained well.

Rabbit No. 12.—Inoculation experiment with plague culture. No. 12 was inoculated on the 9th of July, 1898, with 1 c.c. of a pure culture from the blood of No. 4. Died on the 12th July, of plague.

Rabbits Nos. 13 and 14.—Inoculation experiments with plague cultures. Nos. 13 and 14 were inoculated with 1 c.c. of a pure culture of the plague microbe in broth (13), and agar (14), from the blood of No. 9 on the 14th of July, 1898 They died on the 16th and 19th of July, respectively, of plague.

Rabbits Nos. 15 and 16.—Control experiments. Nos. 15 and 16 were inoculated with 0·5 c c. of putrid blood on the 15th of July, 1898. No. 15 died of septicæmia on the 19th of July, and No. 16 of the same cause on the 21st of July, 1898.

SERIES 2.

Rabbit No. 1.—Test experiment. Inoculated with 3 c.c. of a plague culture on the 2nd of August, 1898; died of plague on the 4th of August, 1898.

Rabbits Nos. 2, 3 and 4.—Prophylactic inoculation experiments. Inoculated with 1 c. c., 3 c.c. and 6 c.c., respectively, of Haffkine's fluid on the 7th of August, 1898. Inoculated with 3 c.c. each of a plague culture on the 10th of August, 1898; died of plague on the 15th (No. 2), 13th (No. 3), and 18th (No. 4) of August, 1898.

Rabbit No. 5.—Control experiment. Inoculated with 3 c.c. of the same plague culture as Nos. 2, 3 and 4 on the 10th of August, 1898. Died of plague on the 13th of August, 1898.

Rabbits Nos. 6, 7 and 8.—Prophylactic inoculation experiments. Inoculated twice with Haffkine's fluid, No. 6 with 6 and 10 c.c., No. 7 with 9 and 15 c.c., and No. 8 with 12 and 20 c.c., on the 16th and 22nd of August, 1898. Inoculated with plague: 1 c.c. on the 27th of August; 1 c.c. on the 11th, 1 c c. on the 14th, and 3 c.c. on the 29th of September; and 1 c.c. on the 8th of November, 1898. All living.

Rabbit No. 9.—Prophylactic inoculation experiment. Inoculated with 2 c.c. and 20 c.c. of a culture of the organisms from Haffkine's fluid on the 18th and 22nd of August, 1898. Inoculated with plague on the 27th of August, 1898. Died of plague on the 31st of August, 1898.

Rabbits Nos. 10 and 11.—Prophylactic inoculation experiment. Inoculated with 9 c.c. and 15 c.c., and 12 c.c. and 20 c.c., respectively, of Haffkine's fluid on the 19th and 22nd of August, 1898. Inoculated with 1 c.c. each of a plague culture on the 27th of August, and 1 c.c. each on the 11th and 14th of September, 1898. No. 11 died of plague on the 15th of September, 1898. The survivor, No. 10, was further inoculated with 3 c.c. of a culture of plague on the 29th of September, and with 1 c.c. on the 8th of November, 1898, and is still living.

Rabbits Nos. 12, 13, 14, 15 and 16.—Prophylactic inoculation experiments. Nos. 12 and 13 were inoculated with 20 c.c. each of a culture of the organisms from Haffkine's fluid on the 25th of August, 1898. No. 12 was inoculated with 1 c. c. of a culture of plague on the 31st of August. 1898, and died of plague on the 6th of September, 1898. No. 13 was inoculated with 1 c.c. of a culture of plague on the 31st of August; with 1 c.c. on the 11th; and with 3 c.c. on the 29th of September; and with 1 c.c. on the 8th of November, 1898; and is still living. Nos. 14, 15 and 16 were each inoculated on the 25th of August with 20 c c., and on the 5th of September, 1898, with 20 c.c. of cultures of Haffkine's organisms. They were inoculated with 1 c.c. each of a culture of plague on the 9th of September, 1898, and they died of plague on the 20th, 15th and 21st of September, 1898, respectively.

Rabbit No. 17.—Control experiment (with Nos. 6 to 11). Inoculated with 1 c. c. of the same plague culture as Nos. 6 to 11 on the 27th of August, 1898. Died of plague on the 30th of August, 1898.

Rabbits Nos. 18, 19, 20 and 21.—Prophylactic vaccination experiments. Nos. 18 and 19 were vaccinated direct from the calf in the ordinary way in three places, and Nos. 20 and 21 in six, on the 30th August, 1898. Nos. 18 and 19 were inoculated with 1 c c. of plague culture on the 9th of September, 1898, and both died of plague on the 14th of September, 1898. Nos. 20 and 21 were inoculated with 1 c.c. of the same plague culture on the 9th of September, 1898, and had a mild attack of plague which they survived.

Rabbits Nos. 20 and 21.—Vaccination and double inoculation experiments. Nos. 20 and 21 having been inoculated with plague after vaccination in six places, and having survived one attack of the disease, were inoculated again, with 3 c.c. of plague culture, on the 29th of September, 1898, and died of plague on the 5th and 4th of October, 1898, respectively.

Rabbit No. 22.—Control experiment (with Nos. 12 and 13). Inoculated with 1 c.c. of the same plague culture as was employed in rabbits Nos. 12 and 13 on the 1st of September, 1898; and died of plague on the 4th of September, 1898.

Rabbits Nos. 23 and 24.—Prophylactic experiments with the organisms cultivated from putrefying urine (healthy). Inoculated with 1 c.c. of culture of diplobacilli from putrescent urine on the 6th and 7th of September, 1898; and with 1 c.c. of a culture of plague on the 13th of September, 1898. Died of plague on the 18th and 22nd of September, 1898, respectively.

Rabbits Nos. 25, 26 and 27.—Control experiments (with, except No. 17, Nos. 14 to 21 inclusive). No. 25 was inoculated with 1 c.c. of plague culture on the 9th of September, 1898; again on the 14th, and again on the 16th. Died of plague on the 26th of September, 1898. On *post-mortem* examination the spleen was enormously enlarged, measuring more than four inches in length. Nos. 26 and 27 were inoculated with 1 c.c. of the same plague culture on the 9th of September, 1898. Both died of plague on the 14th and 17th of September, respectively.

Rabbits Nos. 28 and 29.—Control experiments (with except Nos. 9 and 12, Nos. 6 to 13). Inoculated with 1 c.c. of plague culture on the 11th of September, 1898. Died of plague on the 15th and 16th of September, 1898, respectively.

Rabbit No. 30.—Control experiment (with Nos. 23 and 24). Inoculated with 1 c.c. of plague culture on the 13th of September, 1898; died of plague on the 14th of September, 1898.

Rabbit No. 31.—"Serum" experiment. Inoculated with (home made) Haffkine's "serum," aseptic and free from organisms, 15 and 20 c.c., on the 20th and 28th of September, 1898. Inoculated with 3 c.c. of a plague culture on the 7th of October, 1898. Died of plague on the 12th of October, 1898.

Rabbits Nos. 32 to 36.—Control experiments (with Nos. 6, 7, 8, 10, 13, 20 and 21). Inoculated with 3 c.c. of plague culture on the 29th of September, 1898. Died of plague on the 2nd, 3rd, 1st, 3rd and 1st of October, 1898, respectively.

Rabbits Nos. 37 to 42.—Experiments with vaccination and subsequent inoculation with plague. All this batch were vaccinated in six places on the 7th of October, 1898. They were inoculated with a subcutaneous injection of 1 c.c. of pure vaccine lymph on the 28th of October (37 and 38), the 22nd of October (39 and 40), and the 24th of October (41 and 42). They were inoculated with 1 c.c. of a culture of plague on the 7th of November, 1898, and they all died of plague on the 13th, 13th, 11th, 12th, 12th, and 12th of November, 1898, respectively.

Rabbits Nos. 43 to 48.—Experiments with double inoculation with Haffkine's fluid and subsequent inoculation with plague. All of this batch of animals were inoculated with 20 c.c. of Haffkine's fluid on the 7th of October, 1898; and again with 20 c.c. on the 21st of October. No. 46 died from the effects of the last inoculation on the 22nd of October, 1898. The rest of the batch were inoculated with 1 c.c. of plague culture on the 7th of November, 1898. No. 43 died of plague on the 13th of November; the remaining four are alive.

Rabbit No. 49.—Control experiment (with No. 31). Inoculated with 3 c.c. of a plague culture on the 7th of October, 1898. Died of plague on the 13th of October, 1898.

Rabbits Nos. 50 and 51.—Experiments by inoculation with cultures of earth from the floors of suspected houses in Kotmal. Both these rabbits were inoculated with 4 c. c. of a culture in broth of organisms found in a watery solution of scrapings from the house of Bunnaji on the 11th of November, 1898. Alive—numbers changed to—.

Rabbit No. 52.—Experiments with Haffkine's fluid and subsequent inoculation with plague. This animal was inoculated with 20 c.c. of Haffkine's fluid on the 25th of October, 1898, and again on the 2nd of November. It was inoculated with 1 c.c. of plague culture on the 7th of November, 1898, and is alive.

Rabbits Nos. 53 to 58.—Experiments with watery solutions of floor scrapings from infected houses. All the animals in this batch were inoculated with solutions in water of scrapings from infected houses on the 27th of October, 1898. No. 53 died of plague on the 28th of October, 1898; No. 54 died of tetanus on the 4th of November, 1898; No. 55 is alive; No. 56 is alive; No. 57 died of plague on the 29th of October, 1898; and No. 58 died of tetanus on the 31st of October, 1898.

Rabbits Nos. 59 to 64.—Control experiments (with Nos. 37, 38, 39, 40, 41, 42, 43, 44, 45, 47, 48, 52, and 6, 7, 8, 10, and 13). All the animals in this batch were inoculated with 1 c.c. of a culture of plague on the 7th of November, 1898. They all died of plague on the 11th, 12th, 14th, 10th, 12th, and 11th of November, 1898.

Rabbits Nos. 65 to 70.—Prophylactic vaccination experiments. All the animals of this batch were vaccinated in six places on the 16th of November, 1898. No. 69 died of streptococcus septicæmia on the 22nd of November, 1898. Nos. 65 and 66 were inoculated with 2 c.c. of calf lymph on the 2nd of December, 1898. No. 66 died of tetanus on the 7th December, 1898. Nos. 65, 67, 68, and 70 were inoculated with a subculture of plague, through scratches in the skin, on the 6th of December, 1898. No. 68 died of plague on the 11th of December, and No. 65 died of plague on the 12th of December, 1898. No. 70 died of plague on the 13th of December. No. 67 is alive.

Rabbits Nos. 71 to 79.—Prophylactic inoculation experiments with Haffkine's fluid. All the animals in this batch were inoculated with 20 c.c. of Haffkine's fluid on the 19th of November, 1898. In the case of No. 71 this was followed by very severe ulceration at the site of inoculation. The remaining eight animals were inoculated a second time with 20 c.c. of Haffkine's fluid on the 1st of December, 1898. No. 75 died of toxæmia in seven hours. No. 78 had ulceration similar to the ulceration in No. 71. Nos. 72, 73, 74, 76, 77 and 79 were inoculated with a sub-culture of plague, through scratches, on the 6th of December, 1898. No. 73 died of toxæmia on the 11th of December. The remaining five animals are living.

Rabbits Nos. 80 and 81.—Experiments with plague earth. Both these animals were inoculated with 3 c.c. of a watery solution of prepared earth on the 25th of November, 1898. No. 80 died of plague (?) on the 27th of November, 1898. No. 81 died on the 28th of November of plague and tetanus. The tetanus bacillus was found in pus at the site of inoculation, and the plague microbe was found in large numbers in the blood.

Rabbit No. 82.—Prophylactic vaccination experiment. No. 82 was vaccinated in six places on the 26th of November 1898. An ulcer formed, and this animal has not been used for further experiments.

Rabbits Nos. 83 to 88.—Control experiments—

(*a*) No. 83 was given 1 c.c. of a sub-culture of plague by the mouth on the 6th of December, 1898. Alive.

(*b*) No. 84 was inoculated by a scratch with a sub-culture of plague on the 6th of December, 1898. Alive.

(*c*) No. 85 was inoculated by a scratch with a sub-culture of plague on the 6th of December, 1898. Died of plague on the 9th of December, 1898.

(*d*) No. 86 was given 0·5 c.c. of a sub-culture of plague by the trachea on the 6th of December, 1898. Died of plague on the 9th of December, 1898.

(*e*) No. 87 was inoculated by a scratch with a sub-culture of plague on the 6th of December, 1898. Died of plague on the 12th of December.

(*f*) No. 88 was inoculated by a scratch with a sub-culture of plague on the 6th of December, 1898. Died of plague on the 10th of December, 1898.

Rabbits Nos. 89 to 92.—Prophylactic experiments with the organism from Haffkine's fluid. All the animals in this batch were inoculated with 20 c. c. of a sub-culture of the organisms from Haffkine's fluid on the 7th December, 1898. On the 10th of December Nos. 89 and 91 were inoculated with a sub-culture of plague in a scratch in the skin of the thigh. Nos. 90 and 92 were inoculated through scratches with a sub-culture of plague on the 12th of December, 1898. No. 91 died on the 16th of December, 1898. Three remaining animals in this batch are alive and under observation.

Rabbit No. 93.—Control experiment. No. 93 was given 1 c.c. of a sub-culture of plague by the trachea on the 7th of December, 1898. Died of plague on the 11th of December, 1898.

Rabbit Nos. 94 and 95.—Experiments on young (immune ?) rabbits. The mother of Nos. 94 and 95 is No. 48, which was twice inoculated with Haffkine's fluid on the 7th and 21st of October, 1898, and with 1 c.c. of a plague culture on the 7th of November, 1898. Nos. 94 and 95 were born on the 22nd of November, and were inoculated with a plague culture in a scratch on the thigh on the 7th of December, 1898. Both are alive.

Rabbits Nos. 96 to 101.—Inoculated twice with 20 c.c. of Haffkine's fluid, on the 14th and 17th of December, 1898.

NOTES.

1. The rabbit does not appear to liberate the infection of plague, though it is very susceptible to it.

2. Plague culture in agar is liquefied by mixing a measured quantity of sterilised broth with it in the tube. The culture mixes evenly with the broth, and the agar remains.

3. In the vaccination experiments, we found, on examining the lymph employed in the first inoculations, that it contained many putrid organisms, though the calf had been kept clean in the ordinary way. Eight different kinds of organisms were cultivated from it. The vaccinator was informed of this, and the lymph employed for the subsequent experiments has been since much purer than it was at first.

4. The following rabbits are alive, and are available for further experiment :—

Nos. 6, 7, 8, 10, 44, 45, 47, 48, 52, 72, 74, 76, 77 and 79 have been Haffkinised, and have had plague. Nos. 89, 90 and 92 were inoculated with cultures of Haffkine's organisms.

No. 13 has been inoculated with a sub-culture of the organisms found in Haffkine's fluid, and has had plague.

No. 67 has been vaccinated, and has had plague.

Nos. 83 and 84, and 94 and 95, have had plague. The two latter were born of a doe that had been Haffkinised and had had plague.

Nos. 96, 97, 98 and 99 have been Haffkinised twice.

VI.

MEMORANDUM ON THE METHOD OF DETECTING THE PRESENCE OF PLAGUE INFECTION IN DWELLING HOUSES.

By MR. A. H. STEVENS, *Deputy Plague Commissioner.*

The following memorandum on the method of detecting the presence of the plague microbe in dwelling houses has no pretensions whatever to being scientific; all that is claimed for it is that it describes an easy and reliable method of detecting the infection of plague, and of readily ascertaining its extent.

The method was introduced by the Plague Commissioner of Hyderabad on the outbreak of plague in His Highness the Nizam's Dominions in February, 1898.

When on tour in the infected areas, Dr. Lawrie suggested that I should employ the plan of discovering plague infection in the floors of dwelling houses by means of the microscope, prior to its destruction by fire by the kiln process.

Having adopted that method, I subsequently obtained such uniform results during eight months' experience in testing and experimenting upon plague infection in the Hyderabad State, as well as in British India—in the district of Sholapore and in the City of Bombay—that I have no hesitation in stating my opinion that it ought to be the foundation upon which all plague operations, whether suppressive or preventive, are based.

Plague infection is found in dwelling houses almost entirely on the surface of the floors, and does not, as far as my experience goes, penetrate deeper than half an inch, or so, below it.

Dark, unventilated sleeping apartments usually contain far more infection than well-lighted and well-ventilated dwelling places, shops, or cooking rooms. Open yards, cattle sheds, etc., are, as a rule, free from infection, even in houses in which a large number of deaths from plague have occurred.

Wall surfaces and roofs are generally free from infection, although traces of it may be found on those parts of the walls near the floors.

The first step towards detecting plague infection is to collect the media in which it lurks in nature, *i.e.*, surface scrapings of floor earth. A sterilized flat river shell makes a capital scraper; and, in collecting the earth, care should be taken to scrape off the actual surface of the floor without breaking through the top layer. Sweepings of loose dust give less conclusive results than fine earth detached by scraping from the surface of the floor itself.

In rooms, the infection appears to be unevenly distributed over the floors; and it is therefore advisable to take scrapings from at least three or four different spots in each room. The likely spots to find infection are sleeping places, or places where plague corpses have been laid out, and the undisturbed corners of rooms: the unlikely spots are those near fire places, or close to windows or doorways, and the regular pathways across rooms leading to doorways.

For the purpose of examination only a very small amount of floor scraping is required; as much as will lie upon a rupee is amply sufficient, provided it is collected in the manner indicated above.

The scrapings from each room or house are collected and sealed up, either in a stout paper envelope, or small glass bottle, the name of the village, date, and name of occupant of the house or room, and any other necessary details, being written at the time of taking the scrapings in pencil on a label on the bottle or envelope.

It is advisable, if possible, to examine the scrapings on the same day they are taken off the floor, as the organisms contained in it not infrequently die out rapidly.

If the scrapings have to be sent any distance for examination, a thin slice of raw potato may be put in each bottle to provide nutriment and moisture.

Each bottle should be well wrapped up in thick paper to prevent the action of light upon its contents.

The following apparatus and chemicals are required for making preparations of floor earth and examining them:—

A small field microscope with a one-twelfth oil immersion lens. One ounce of cedar oil for immersion. Fifty to one hundred best flatted crown glass slides three inches by one inch. Three ground glass slides with depressed circle and clear glass in centre for hanging-drop preparations.

Two hundred and fifty to five hundred cover glasses, either round or square; only those extra thin and sold as No. 1 are of any use, as thicker ones are useless with the high power oil immersion lens.

Six watch glasses.
One spirit lamp.
One cornets cover glass forceps.
One platinum needle.
Two camel hair brushes.
Blotting and filter paper.
One pint of methylated spirit.
Two ounces absolute alcohol.
Two ounces xylol.
One ounce vaseline.
One ounce Canada balsam.

Stains. For violet stain for general use, ***Aniline Gentian Violet***, composed of saturated alcoholic solution of gentian violet 30 c.c., aniline water 100 c.c.; stain for 2 to 3 minutes.

For ***red*** stain, *Zieht Neilsens Solution* of Carbol Fuchsin:—

Fuchsin	1 part.
Absolute alcohol	10 parts.
Five per cent. aqueous solution of carbolic acid	100 parts.

Stain for 1 to 2 minutes.
For *blue* stain, ***Loffiers Alkaline Methylene Blue.***
Concentrated alcoholic solution of methylene blue 30 c.c.
Solution of caustic potash 0'0 per cent. 100 c.c.
Stain for 1 to 10 minutes.

The method of making floor earth preparations is as follows:—

Over a clean watch glass spread a small square of fine linen, and empty into this the dry floor scrapings. Add about a quarter of a teaspoonful of distilled or filtered water, macerate and strain through the linen into the watch glass below. This removes all the grosser impurities. Should it be intended to preserve specimens, the solution can be again filtered through the ordinary grey filter paper. One loopful of the solution should now be placed with the platinum needle upon an absolutely clean cover glass, and spread evenly over its entire surface and allowed to dry. It should then be passed high up three times through the flame of a spirit lamp, to fix the film on the glass, and stained in a watch glass partly full of any of the staining solutions mentioned above, the film side of the cover glass being downwards in the staining solution. Next, remove the cover glass with the forceps, well wash it in water and allow it to dry. The preparation or film is now ready for mounting, which is done by placing a droplet of Canada balsam, which can be made fluid with the addition of a little xylol, on the centre of a perfectly clean slide; the cover glass, film-side downwards, is placed on the balsam, and gentle pressure applied to its upper surface to ensure the balsam spreading evenly, and thus fixing the cover glass securely to the slide.

The preparation is now ready, and should be labelled with the name of the house or village, and the date, and can be examined at leisure.

Hanging-drop preparations are made by placing, with a platinum needle, a loopful of the *unstained* floor earth solution on a clean cover glass; a hollow ground slide with a fairly thick ring of vaseline painted round the hollow—the ring of vaseline downwards—is then placed on the cover glass, so that the drop of solution is situated in the middle of the hollow but not touching the slide at any point. The cover glass adheres to the slide by means of the vaseline, and on quickly inverting the whole so that the drop of solution has no time to run, it will be found hanging from the under-surface of the cover glass in a cell which is hermetically sealed by the vaseline.

The hanging drop preparation is the only certain method of ascertaining whether an organism is mobile or not.

All staining solutions should be filtered before being used; the best results are usually obtained by diluting them with water and allowing the film preparations to soak in the diluted solution for from 5 to 15 minutes.

Xylol is used for melting the Canada balsam to remove the cover glass from the slide, also for clearing off the dry cedar oil used in immersion from the upper surface of the cover glass.

For rapid working in camp, and when it is not intended to preserve the films, water may be substituted for the Canada balsam mounting, and also water may be used instead of oil for immersion.

Preparations may be first mounted in water and examined and then, should it be desired to preserve them, all that is necessary is to remove the cover glass from the slide, dry and remount in the usual way with balsam.

The colour in preparations stained with aniline dyes is apt to fade after a month or so. To re-stain, remove the cover glass with xylol, wash in xylol to remove the balsam, dry, re-stain and re-mount.

Gram's Method of Decolorisation.—The plague bacillus both in its rod and coccoid forms responds fully to Gram's method, *i.e.*, having been stained, it decolorises readily when treated with Gram's solution. The following description of the method is taken from Muir and Ritchie's Manual of Bacteriology:—

"(1) Stain in aniline oil gentian violet for about five minutes and wash in water.
"(2) Treat the film with Gram's solution made with iodine . . 1 part,
" Potassium iodide . . . 2 parts,
" Distilled water . . . 300 parts,

"till its colour becomes a purplish black; generally about "half a minute or a minute is sufficient for the action to "take place.

"(3) Decolorise with absolute alcohol or methylat-"ed spirit till the colour has almost entirely "disappeared, and the film appears only a very "light violet.
"(4) Dehydrate completely, wash in water, dry "and mount."

To obtain the best results everything must be scrupulously clean, and the slide and cover glass free from the least trace of grease. It is a good plan to keep clean cover glasses ready for use in absolute alcohol, or carbolic, or cedar oil.

For rapid working, the cover glasses may be dispensed with altogether, and the floor earth solution spread directly on the slide itself, dried, stained, dried again, and then examined. The drop of oil, or water, for immersion may be placed on the film surface. If it is desired to keep the specimen, if water immersion, dry it; or, if oil immersion, remove the oil with xylol, and place a droplet of Canada balsam on the film on which a clean cover glass can then be mounted.

The appearance of the plague microbe in floor scrapings can be seen in Plates I, X, and X*b*, on pages 3 and 4, and this appearance is so uniformly characteristic, and so invariably present where plague infection exists, that, as far as my experience goes, it can never be mistaken for anything else but what it actually is, *viz.*, a positive indication of the presence of the virus of the disease.

VII.

MEMORANDUM ON THE TREATMENT OF PLAGUE-INFECTED PREMISES AND THE DESTRUCTION OF THE INFECTION BY THE KILN-PROCESS OF BURNING.

By A. H. STEVENS, Esq., *Deputy Plague Commissioner.*

On a case of bubonic plague, or of suspected plague, occurring in a house, the following treatment of the house and its occupants should be adopted without delay. In the case of the first appearance of plague, or suspected plague, in a single house or group of huts in a hitherto uninfected town or village, the following entire course of evacuation and disinfection should, if possible, be completed the same day, or, at latest, within the ensuing 24 hours.

The infected or suspected house must be promptly evacuated of its occupants and completely emptied of all its contents, the occupants obtaining temporary shelter under the shade of trees, etc., or even remaining in the open fields, until huts are constructed. This operation usually only takes a few hours, the huts being constructed of sticks or bamboos covered in with gunny bags, matting cloth, brushwood, palm leaves, jowari stalks, grass, straw, or whatever other suitable material is available.

The house, having been evacuated, must next be completely emptied of the whole of its contents, such as beds, furniture, grain, cotton, bags, boxes, bales, pots, pans, grinding stones, etc.; every single article must be removed, and nothing but the bare walls, floors, roofs, and doors left. If the site of the future encampment is at some distance from the house, all the property should first be collected in a convenient spot not more than 20 or 30 yards from the evacuated house, and, if exposed to the sun, so much the better. A Government guard should be placed over the property until the occupants are able to remove it to the encampment.

An inventory should now be made of the number of rooms, verandahs and yards in the house to be disinfected, to be again taken after the process of disinfection is complete, so as to preclude the possibility of any portion of the premises being overlooked and not disinfected.

Until the labour, tools and materials for disinfection are at hand, the house should be kept locked, nobody being permitted to enter it.

The following tools and materials are required, the number or quantity of each depending on the size of the house to be disinfected:—

(1) Some buckets of thick lime-wash with brushes.

(2) Spades, pickaxes, and iron baskets.

(3) A cartload or more of "ooplies" (dry cowdung fuel cakes).

(4) Perchloride of mercury solution 1 to 1,000 parts of water.

It having been authoritatively decided that the infection of plague is to be found on the surface of the floors of houses occupied by persons suffering from plague, the destruction of this infection is the first object to be aimed at. The most perfect disinfectant for plague is *fire*, which effects the almost instantaneous destruction of all trace of the infection. Various methods of applying fire *in situ* to the floors and walls of infected buildings have been tried, such as kerosine oil sprinkled over the floor surface an then fired, or thin layers of straw, chaff, sawdust, or pounded "ooplies" etc., spread over the floors, sprinkled wit kerosine oil and then fired; but after a prolonged trial al were rejected for two reasons. First, it was found that the destruction of the infection was not complete, and patches of the floor still retained the infection after the surface burning. Secondly, a great danger was run of setting fire to the roof and burning the house down altogether. To meet these objections, the kiln method of destroying the infection was introduced. It is carried out as follows:—

The kiln-method of destroying plague infection.

The infection of plague does not penetrate to any appreciable depth below the surface of the floor in which it is found; it is, therefore, only essential that no portion of the actual floor surface escapes removal from the house and subsequent destruction by burning in the kiln.

The surface of all floors and the lower portion of walls, 2 feet from the floor surface, is first to be painted over with rather thick lime-wash and allowed to dry. This serves two useful purposes:—(1) it lays the dust, and thus lessens the risk of inoculation to the coolies working in the house; and (2) it colours *white* every part of all surfaces that have to be removed and burnt. The whitened surface is easily seen, and there is little or no chance of any portion of the infected earth remaining behind and being left unburnt.

While the lime-wash is drying on the surfaces, the foundation, or floor of the kiln in which the surface earth is to be burnt, should be laid. The kiln should be made in any sufficiently large-sized courtyard, garden, or open space in or near the house; or the road or pathway immediately facing the front entrance of the house can be used. A circular kiln will be found the most convenient in shape. The floor of the kiln is made of two layers of "ooplies," 4 inches deep, laid flat and packed closely together. The mud floor of the infected house should be carefully dug out to the depth of 1½ inches from every room, verandah and yard which has been whitewashed, and filled into iron baskets, or empty kerosine oil tins; if possible, without spilling or raising any dust. The dug-out earth should now be carried to the kiln and evenly spread over the "ooplies," which form the floor of the kiln, to a depth of 1½ inches. This, the first layer of infected earth, is then completely covered with a layer of "ooplies" 2 inches deep, upon which a second layer of earth is spread and covered with "ooplies," then a third layer of infected earth, and so on with alternate layers of infected earth and "ooplies," until the kiln is complete. One-and-a-half to two feet is the best height for a kiln. Lastly, the kiln is covered in from top to bottom with two layers of "ooplies." It should then be fired at the base, and allowed to slowly burn itself out—a process that usually takes about 48 hours. It is, however, advisable not to disturb the ashes of the burnt kiln for a week, as it continues to smoulder for about that time. When the kiln has cooled down, it should be opened in one or two places and examined, and, if found completely burnt out, the ashes should be removed to cultivated lands and used for manure.

The entire lime-washed surface of the infected floors having been dug out and burnt in the kiln, all that remains to be done to the infected house is to fill in the empty floor space with fresh field earth, moisten it with water, and consolidate it by ramming; subsequently, mudplastering, or "leeping" it. Finally, the new floor surface and walls should be well drenched with perchloride of mercury solution of the strength 1 to 1,000 parts of water. The house is now perfectly disinfected, and as soon as the floors have dried it is fit for occupation.

The accompanying drawings in elevation, cross section and ground plan, are of a circular kiln, the diameter of which is 5 feet, and the height 1½ feet.

VIII.

No. 1125, dated Camp Kopbal, 17th January 1899.

From—A. H. Stevens, Esq., Deputy Plague Commissioner, His Highness the Nizam's Dominions.

To—Lieut.-Col. E. Lawrie, M.B., Plague Commissioner, Hyderabad State.

I have the honour to herewith enclose a statement of plague statistics asked for by the Plague Commission in the form given me by the Secretary to the Commission. Only those villages have been included in the statement in which kiln-burning of the entire village has been completed. I shall be much obliged if you will kindly forward the statement to the President of the Plague Commission.

No. 432, dated Hyderabad Residency, the 22nd January 1899.

From Lieut.-Col. E. A. Lawrie, M.B., I.M.S., Plague Commissioner, Residency Surgeon.

Copy, with statement, forwarded to the President, Plague Commission, Calcutta, for information.

Plague Statistics for submission to the Plague Commission.

1	2	3	4	5	6				7	
					NUMBER OF CASES AND DEATHS BETWEEN DATES				TOTAL.	
					IN COLUMNS 3 AND 4.		IN COLUMNS 4 AND 5.			
Name of village.	Population.	Date (approximate, if not exactly known) of entry of plague.	Date when evacuation and kiln-burning were completed.	Date of last case.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Gonjoti . .	3,000	13th January 1898.	16th February 1898.	15th March 1898	192	192	51	46	243	238
Umarghi . .	3,000	25th December 1897.	9th February 1898.	30th March 1898	100	100	94	88	194	188
Tirrori . .	800	7th February 1898.	11th February 1898.	25th March 1898	8	8	17	14	25	22
Chincholey .	600	9th February 1898.	Not evacuated.	9th February 1898.	1	1	...	...	1	1
Bulsoor . .	850	13th February 1898.	25th February 1898.	29th March 1898	23	23	38	28	61	51
Sirsi . .	1,500	9th February 1898.	1st March 1898	11th May 1898 .	39	39	27	26	66	65
Maraj . .	1,200	8th February 1898.	8th March 1898	11th April 1898 .	21	18	29	26	50	44
Sangni . .	720	12th February 1898.	Not evacuated.	12th February 1898.	1	1	...	...	1	1
Dalim . .	687	1st February 1898.	Ditto.	1st February 1898.	4	4	...	...	4	4
Wadi . .	400	16th February 1898.	Ditto.	16th February 1898.	4	4	...	...	4	4
Kajurgi . .	1,700	24th January 1898.	26th February 1898.	27th March 1898	13	12	9	9	22	21
Chandkal .	655	11th February 1898.	Not evacuated.	11th February 1898.	3	3	...	...	3	3
Nagral . .	480	4th March 1898	12th March 1898.	2nd April 1898 .	5	4	3	4	8	8
Akoondi . .	598	13th March 1898.	Not evacuated.	23th March 1898	2	1	...	...	2	1
Alanga . .	500	1st May 1898	Partially evacuated.	13th May 1898 .	5	5	...	...	5	5
Nanaz . .	2,206	24th January 1898.	2nd February 1898.	26th March 1898	12	8	57	47	69	55
Sambulwadi .	607	7th October 1897.	16th October 1897.	19th December 1897.	4	3	12	13	16	16
Karamba . .	941	13th January 1898.	1st February 1898.	8th March 1898	36	32	27	22	63	54
Warleygaon .	245	4th January 1898.	1st February 1898.	24th January 1898.	24	20	...	...	24	20
Khadkey . .	502	30th December 1897.	2nd February 1898.	14th February 1898.	25	18	17	17	42	35
Dhotri . .	764	14th October 1897.	1st January 1898.	7th February 1898.	34	27	39	39	73	66
Katgaon . .	1,750	13th March 1898.	16th March 1898.	24th March 1898	7	3	4	3	11	6
Palaskhed .	1,200	23rd January 1898.	10th March 1898.	6th March 1898	71	71	...	...	71	71
Kasegaon .	743	28th December 1897.	4th February 1898.	14th March 1898	43	31	9	8	52	39
Sarati . .	484	18th January 1898.	4th February 1898.	4th February 1898.	24	20	...	...	24	20
Babulgaon .	120	12th July 1898	Partially evacuated.	17th July 1898 .	16	5	...	2	16	7
					717	653	433	392	1,150	1,045

Camp Kopbal;
The 17th January 1899.

A. H. Stevens,
Deputy Plague Commissioner, Hyderabad.

APPENDIX No. XIX.

NOTES ON

INOCULATIONS WITH HAFFKINE'S PLAGUE PROPHYLACTIC FLUID

IN WARDHA AND NAGPUR.

Dr. Revie, of the Free Church Mission in Wardha, has done in all 201 inoculations, of which there is a four-hourly record of temperature in 57 only.

In Nagpur, 87 inoculations have been performed by myself and assistants, of which temperature charts have been obtained of 73.

There are thus 130 temperature charts in all.

There have been few people presenting themselves for inoculation and there is great difficulty in obtaining four-hourly records of temperature.

In all six different brews have been used, and, if sufficient allowance is made for alterations in dose, there does not seem to have been any marked difference in the results obtained from individual brews.

There has been practically no plague in Nagpur and very little in Wardha, so that it is impossible to state how far these inoculations may be considered to have protected the recipients against plague. As far as is known, none of these persons have had plague since inoculation ; no one has been inoculated twice.

Taking Professor Haffkine's standard of 102° Fahr. as the requisite temperature to be considered a "reaction", the results are as follows :—

Nagpur Inoculations.

Reactions.	Non-reactions.	Total.
53	20	73

i.e., 72·6 per cent.

Wardha Inoculations.

Reactions.	Non-reactions.	Total.
30	27	57

i.e., 52·7 per cent.

The difference between the two series is even more marked when it is noticed that in the Nagpur inoculations in only three cases did the temperature not reach 101°, whereas in the Wardha series seven cases out of a smaller total failed to reach 101°. In all the inoculations there was a rise of temperature of at least a degree and-a-half. In only three cases have there been any serious ill-effects noted. They are :—

(1) Hospital Assistant Kashinath Gopal.

(2) Bee Luxshmee.

(3) Dr. Sandilands, Wardha.

A reference to their charts will show the symptoms complained of.

With regard to the different brews, the results were as follows :—

Nagpur.

	Reactions (*i.e.*, temperature 102° or over).	Non-reactions.	Total.
Brew No. 4961	6	2	8
„ „ 4731	11	4	15
„ „ 5247	15	7	22
„ „ 4746	5	2	7
„ „ 5261	2	...	2
„ „ 4900	14	5	19
	53	20	73

Wardha.

	Reactions (*i.e.*, temperature 102° or over).	Non-reactions.	Total.
Brew No. 5261	25	24	49
„ „ 4961	5	3	8
	30	27	57

The large number of non-reactions in brew No. 5261 may be attributed to the low doses given to the women and children.

In Nagpur several *women* showed a much higher reaction than normal to one brew—No. 5247—possibly because the dose was not sufficiently lowered. The above data are hardly sufficient to come to any conclusion, but so far as they go, they would seem to indicate that there is no marked difference between the results obtained from the different brews.

On returning from Wardha, I again examined the brew No. 4731 (from which the inoculations on Dr. Hogan and his assistant, which were followed by severe results, were taken—*vide* evidence at Wardha).

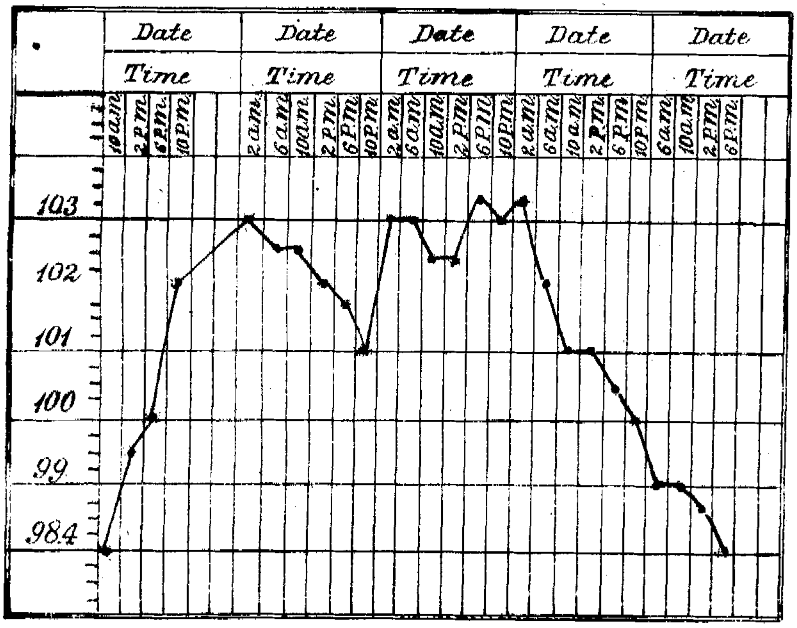
I saw sarcinæ on examination of the precipitate, and on cultivation I obtained a flattish yellow circular colony, which on being stained shewed long wavy bacilli.

On reading the evidence of Dr. Nield Cook in Calcutta, I wrote asking him to send me his slides. In comparing them I find they are identical. This may be of use in corroborating Dr. Cook's evidence. I am unable to say what the bacilli are.

I subsequently used this brew No. 4731 in diminished doses without any ill effects.

J. A. HAMMOND,
Inspecting Medical Officer, Nagpur.

Name Kashinath Gopa Age 27 Brew Nº 4863 Dose 2½ C.C.
Fathers Name Gopal Rao Date Inoculation 18-12-98 at 10 a.m. Dose given 3 C.C.



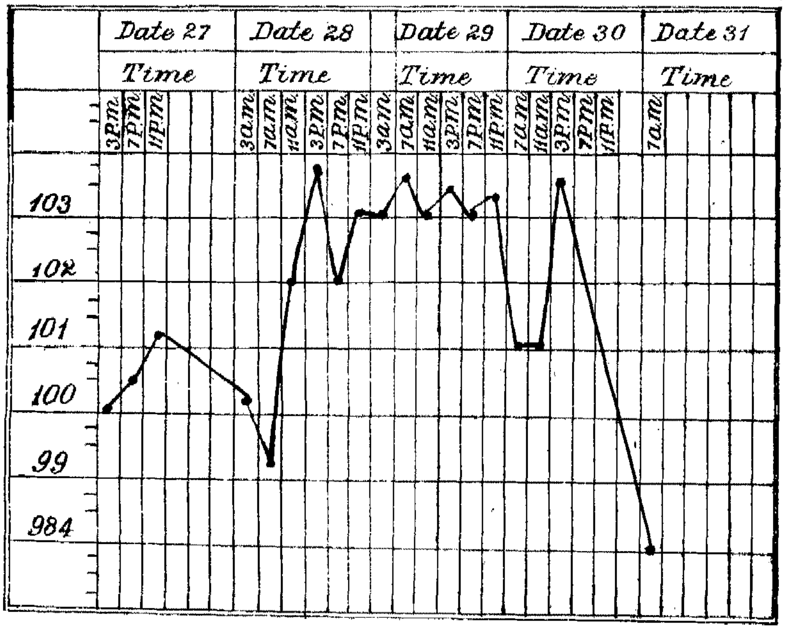
General symptoms and time of the occurence:-

Slight bronchitis headache.

Local symptoms

Severe œdema and pain in arm and fore arm Glands in axilla not enlarged.

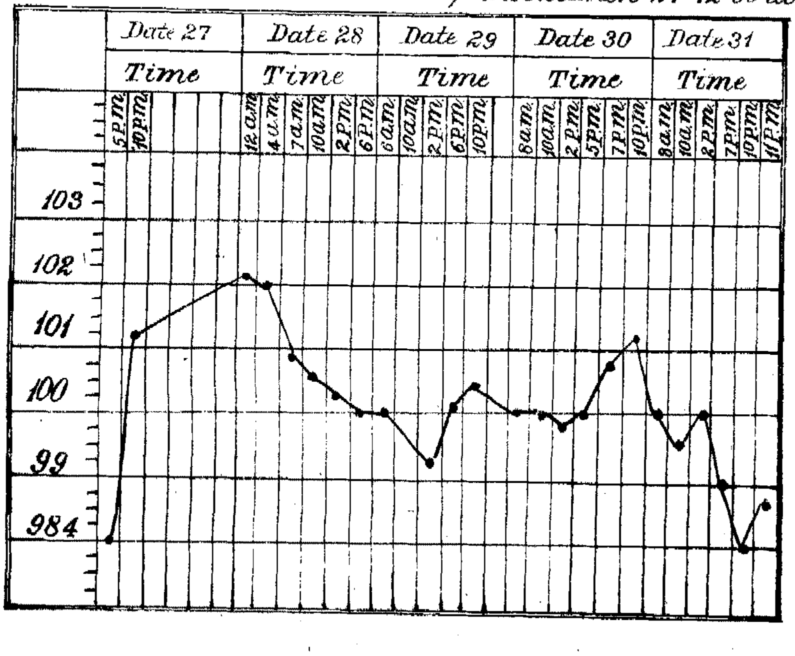
-Female-
Name Bee Laxmi Age 20 Brew Nº 5247 Dose 7½ C.C given 6 C.C.
Father's name Chandoo. Date Inoculation 27.12.98 at 2 P.M.



General symptoms and time of the occurrence:-

Continued pyrexia with crisis Commenced on 2nd day

Name J Sandilands Age 38 Brew Nº 5261 Dose 6¼ C.C
Date of inoculation 27-12-98 at 6 P.m.



General symptoms and time of the occurrence:-

Temp. Came down to normal on the 2nd Jan. 99 at 7-30 a.m.

APPENDIX No. XX.

REPORT

ON

PLAGUE IN CALCUTTA.

BY

J. NIELD COOK, D.P.H., HEALTH OFFICER.

The present site of Calcutta is said to have been originally selected by Job Charnock, the founder, for his trade emporium, because there was a large shady tree under which he could enjoy his repose and his *hookah*. It possesses few advantages except the proximity of the river Hooghly, being flat, lowlying and alluvial. By making a large number of tanks the level has been somewhat raised in parts, but most of these tanks are so exceedingly foul as to come within the category of nuisance. In the native quarters of the town buildings have been run up under little control, so that they are crowded together on the site. Add to this an increasing population, defective system of sewerage and an insufficient establishment of scavengers, and no sanitarian will be surprised that in spite of a considerable expenditure on the part of the town authorities the health of the town has steadily deteriorated, as shown by the following figures:—

Years.	Deaths from fever.	Fever rates.	Total deaths.	Death rates.
1889	5,994	8·8	19,564	28·7
1890	6,792	9·9	20,368	29·8
1891	7,815	11·5	21,517	31·5
1892	7,618	11·1	20,180	29·6
1893	8,091	11·8	20,103	32·5
1894	8,963	13·1	22,441	32·9
1895	11,345	16·6	27,031	39·6
1896	9,564	14·0	24,356	35·7
1897	9,619	14·1	24,665	36·1

From 1889 to 1893 the mean death-rate from fevers was 10·6, and the total death-rate 29·8.

From 1894 to 1898 the mean death-rate from fevers was 14·4, and the total rate 36·1.

It is emphatically asserted by some of the oldest inhabitants that plague has never been in Bengal, and that for some occult reason it could not take hold here if it came. Apart from Dr. Simpson's supposed cases, which are controversial, I think it may be admitted that there has been no epidemic of plague in Bengal in the present century, as no record of it can be found in the Imperial Library, and most of the old medical records of Calcutta appear to have been eaten by white ants or otherwise resolved into their primordial principles. Dr. Simpson recently stated in a paper read before the British Medical Association that vernacular records show that plague was present in Calcutta 200 years ago. I have made inquiries in various quarters, but have not been able to unearth any such records. The town of Calcutta is said to have been founded in 1690 when the standard of England was hoisted on the banks of the Hooghly by Job Charnock, and though a native town or village, called Kálishetrah, previously existed in the neighbourhood, it appears to me that too much reliance should not be placed on any records of the time that may have survived as proving the existence of plague, unless the clinical description of the disease makes it unmistakable. The following extract from "Transactions in Bengal" certainly reads like a page out of Defoe's "Memoirs of the Plague Year," and it relates to 1770, the year of the Great Plague of Moscow, which was supposed to be imported from the East:—

"The year 1770 was memorable for a grievous famine and pestilence which afflicted Bengal generally and carried off, according to Mr. Hickey, 76,000 souls in the streets of Calcutta between 15th July and 10th September.

"There was not a corner in the city or any lurking-place in the vicinity of Calcutta where the living, the dying and the dead were not mingled or heaped together in melancholy confusion. It was impossible to stir abroad on business or recreation where these offensive and mortifying associations were not in the way. The daily employment of hundreds was to remove the dead in proportion as they became a nuisance to the living. These, in cart-loads and without any religious obsequies, were promiscuously plunged into the river. By this increasing and prodigious mortality, notwithstanding the most constant attentions to decency and cleanliness, the town and suburbs were so much infested that from the raging heat of the weather, the foul congregation of vapours, which incessantly ascended from the unburied dead, or intemperate state of the atmosphere, a pestilential influenza was generally and seriously apprehended. Fortunately, an extraordinary flock of carnivorous birds, animals and vermin were allured from their fastnesses and their solitudes by the putrefaction of the scene. The water of the Ganges became loathsome and corrupt from the loads of dead bodies which it daily received. Pork, geese, ducks and every species of provisions fattened by substances thus gross and abhorrent were avoided as poisonous. The fish in the river were noxious and even sometimes fatal to those who ate them. Mutton, which could hardly be obtained at any price, became the only food which could be enjoyed with safety and satisfaction."

Certainly there are few diseases besides plague that could kill three-quarters of a lakh of people out of a population of three-and-half lakhs, or 20 per cent. in 8 weeks, though typhus, relapsing fever and small-pox following in the wake of a severe famine might do so. It is also possible that a pernicious malaria might do so before the introduction of the cinchona alkaloids.

Going back still farther into the past we find that Gaur, the ancient capital of Bengal, was depopulated by a plague which is thus described in "Gaur: Its Ruins and Inscriptions," by J. H. Ravenshaw, B.C.S.:—

"In A.D. 1575 Munim Khan, Akbar's Governor, then established at Tondah, charmed with the situation of Gaur, moved thither his troops and all the public officers. The season being unhealthy at the time, the vast influx of inhabitants caused a pestilence in the city, the mortality was so great that the people were no longer able to burn or bury their dead. The corpses thus left were thrown into the moat, the river, or the numerous reservoirs, and the stench arising from them necessarily aggravated the plague. The few that survived left the city which was never populated again to any extent."

I am inclined to think the plague alluded to was a pernicious malarial fever, for in the *Calcutta Review*, 1879, vol. 69, page 74, we read:—

"The river spoken of by the Minhaj-us-Siraj ran perhaps very nearly where the Bhagirotee now runs, and gradually cut away its western bank, with the half of Gaur which stood thereon, working for itself a new channel ever westward and more westward, and throwing up against its eastern bank a low alluvial slope frequently flooded and again dry and reeking with pestilential miasma. To this action of the river may have been due the plague which swept away the inhabitants in thousands, and is said to have caused the final desertion of the place."

It is an historical fact that there have been fearful pestilences in the past on this side of India which have depopulated whole cities, more instances of which might be adduced, but there is no evidence to show that they were in any case true bubonic plague. Dr. Lind, in his work on "Tropical Diseases," published in 1776, writes: "If the season be very sickly, some are seized with a malignant fever of which they soon die; the body is covered with blotches of a livid colour and the corpse in a few hours turns quite black and corrupted." These blotches might be the "tokens" described by Defoe and other writers, but in the absence of any description of glandular swellings, which form such a marked characteristic of the disease as to be noted even in the Biblical accounts, it is more probable that the fever alluded to was typhus or hæmorrhagic small-pox. The only allusion to glandular enlargement in pernicious fever I have seen was in Busteed's "Echoes of Old Calcutta." but the enlargements alluded to were said to be most frequently in the neck, an unusual place for true plague buboes.

Whether plague has or has not previously appeared in Calcutta it is certain that medical prophets, ancient and modern, have pointed to the writing on the wall, that is clear to the eyes of any sanitarian, and cried aloud to the city its danger from plague or pestilence. Early in the present century Sir James Ranald Martin wrote in his "Notes on the Medical Topography of Calcutta," (1837) :—

> "The north division between the Bow Bazar and Machooa Bazar comprises perhaps the most dense part of the native population of Calcutta. It is surprising how much the condition of the native portion of the town has been neglected in this great city and its suburbs, in which are to be found all the faults of all the cities in India. It may not be very easy efficiently to interfere in this matter, and it may be very true that it is less difficult to find fault than to remedy the evil complained of; but in an affair of so much importance to the public health *something* may be done and at least ought to be tried, if only in the way of Municipal or Police Regulation.
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> "In the event of a contagious disease (and there is no reason why such should not occur here), the dense state of Burra Bazar and surrounding parts, the want of water-courses and means of facility for removing accumulations of filth, etc., would stand as insuperable bars to the best devised regulations of medical police. All masses of buildings should be opened out, old walls and decayed houses removed, for even under ordinary circumstances these are fertile sources of fever."

Though money has been spent and improvements have undoubtedly been effected in the cleansing of the town, the state of the native quarters is very much the same as it was sixty years ago when Sir Ranald Martin described it. For in the report of the Health Officer of the Corporation of Calcutta for 1896 Dr. W. J. Simpson wrote :—

> "The appointment of a Building Commission will form, I believe, the commencement of a new era in the sanitation of Calcutta, for it is the first serious attempt to inquire into and deal practically with the ever-increasing irregular growth of the town and the suburbs, and with over-crowded and unhealthy areas. It is this irregular growth which interferes with every sanitary reform, and it has reached even for Calcutta to such an extraordinary stage in Burra Bazar and Jora Bagan as to render these districts as bad, if not worse, from a sanitary point of view than any to be found in any eastern city.
>
> "The condition of the worst of these areas is indescribable. Ocular demonstration alone conveys to the mind a state of affairs that words fail to depict. Every one I have taken over the area, bounded by Rutton Sircar's Garden Street on the north, Canning Street on the south, Chitpur Road on the east and Clive Street and Durmahata Street on the west, is unanimous in condemning it as unfit for human habitation and a source of danger to the town. The whole area is intersected by narrow lanes and passages ranging from 6 to 20 feet in width. Only one broad road, Harrison Road, and that recently constructed, passes through it from east to west. The houses facing the narrow streets are two, three and four storeys high and often separated from one another by passages two or three feet wide. In these narrow passages, in such situations as often to be almost inaccessible, are the latrines of the houses, which in many cases are merely compartments with openings in the floor communicating with a long shaft leading to a dark and ill-ventilated privy vault, where the excreta have in consequence of their long descent splashed in every direction and formed a cess-pool which it is impossible to clean properly. The houses are chiefly inhabited by Marwaries whose habits are such that all refuse is thrown from whatever part of the house they occupy into the court-yard in the centre of the house, or into the passages between the houses, some of which are so narrow as to suspend in mid air kerosine tins or similar articles which may be thrown from the upper storeys. The narrow ill-ventilated streets, the passages to which neither light nor fresh air have access, the filthy condition of both, the close proximity of the houses to one another and their over-crowded state combine to form conditions which render proper sanitation impossible. It is a satnding menace to the rest of the city, and should plague once obtain a firm footing in this quarter, which is the worst I am acquainted with in any city I have seen, there is every likelihood of the disease becoming endemic."

To this may be added that there are large granaries in or near this quarter of the town which are infested with rats, and we have an unique provision for the conveyance of infection from house to house, even if the people shut themselves up in their houses and cut themselves off from all outside communication, as many did in the Great Plague of London. It was considered inexpedient to start a systematic campaign against these rodents, as the Marwaries and some of the other classes of the population object to their slaughter, and it was feared that any such undertaking would cause serious disturbances. It appears that the rats enjoy the special protection of *Ganesh*, the elephant-headed God of Wisdom. A cartoon of this popular deity appeared in the *Bangobasi*, one of the most widely read vernacular papers :—"These poor creatures," he says, "have not been to Bombay, but were born and bred in Bengal. How then can they import plague?" In spite of this *pronunciamento* of Wisdom, the general belief of epidemiologists is that rats have imported plague, not only into other towns, but also into Calcutta, though not rats born and bred in Bengal, who only aided the spread of the infection after its importation.

During the early part of the year 1898 the health of the town as shown by the vital statistics was better than usual, the death-rate for the first quarter being 33·4 against an average of 38·2 per mille per annum. There was nothing abnormal in the seasonal conditions. The first indication I received of plague being in the town was a letter from the Secretary to the Agent of the East Indian Railway Company delivered on the 15th April, informing me that dead rats had been found in the Company's Printing House in Fairlie Place near the wharves on the river. I visited the place and obtained the following information from the Superintendent of the Printing Department :—"About 16 dead rats have been found in the last week. We have never found any before. All except 2 or 3 were decomposed. They were discovered through the smell, and we poked them out of the type-racks with a stick, so I did not notice the position in which they lay. None were found this morning. No sick rats have been seen. All the rats appeared to be of the same breed as is usually seen here. There was a pot of paste containing blue stone left open in a corner of the room which they might have eaten. It was removed this morning." Rats were subsequently sent to me for examination. I found no trace of copper in them. They were most of them more or less decomposed; and though one of them had a bubo, I did not succeed in getting the plague microbe from any of them. It was noticeable that the lungs in several of those rats were deeply congested, and the right side of the heart engorged. Some of them had cystic disease of the liver, and in two or three there was acute degeneration of the liver. I found no extravasations of blood. So the result of my examination was unfortunately negative. However, I considered the circumstance so suspicious that I advised the thorough cleaning out and disinfecting of the premises, which was subsequently carried out.

The same week there was a report of dead rats being found in certain houses in Ezra Street. Surgeon-Major Dyson and I investigated it, but the residents of the houses obstinately denied that any such mortality had occurred. About the same time rats were reported to be dying in the Steam Navigation Company's godowns, in which imported goods were stored: sick rats were also seen there. Bacteriological cultures and microscopic examinations showed that these rats were infected with plague. These godowns are near the jetties where the Company's ships unload, and it was thought probable that the disease was imported from some infected port by a ship's rats without any of the crew or passengers being infected. There was absolutely no evidence to show that the disease had been imported by land. The first human plague case that came to my notice occurred in Kapalitola Lane near Bow Bazar. The following is the report I made to the Chairman :—

> "I was called up at 2-30 A.M., on Sunday morning, the 17th April, by the Inspector of Police, Bow Bazar, and accompanied him to Kapalitola Lane. There I saw the dead body of a man in a *kutcha*-built *modi* shop, where *ghee* and a few other comestibles were sold. The deceased appeared to be about 30, and was a fine strong man. He had a left femoral bubo presenting the characteristic appearances of a plague bubo. One man, his brother, was with him. The police sent the body to the Morgue, and I roughly disinfected the place with disinfectants which I had brought with me. At 8 A.M. Surgeon-Major Dyson,

the Sanitary Commissioner, attended the *post-mortem* examination made by Surgeon-Major Gibbons, the Police Surgeon. There were large extravasations of blood extending from the affected gland upwards and downwards: also small extravasations on the heart, bowels, etc. These appearances are very characteristic of plague. The signs generally pointed to death from an acute blood poisoning probably plague. I made bacteriological cultures, and will report the results. The deceased had not left Calcutta for some time, and the source of his infection could not be traced The history of the case as I got it was as follows:—The deceased passed Thursday night at the house of a woman. On Friday morning he returned home and went out as usual to hawk *ghee* He returned at 11-30 A.M., somewhat earlier than usual, and took his meals, though he complained of pain in the groin, and feeling unwell. At 1 P.M. the pain was worse, and he had a shivering fit (Rigor) not followed by sweating. The fever increased, and became very severe. He was very restless and tossed about on his bed. He complained once that his heart was bursting. He took some milk with sago that was given him. On Saturday morning he was unconscious, and remained so till 10-30 P.M., when he died.

"On Sunday morning the hut was thoroughly disinfected with the Equifex Steam Sprayer in the presence of Surgeon-Major Dyson and myself. Screens which obstructed light and air were removed and burnt, and nearly half the tiles taken off the roof. The contents of the shop, with the exception of a few papers, were burnt on the spot after being sprayed over. Several buckets of disinfectants were poured down the rat-holes, some of which were under the bed on which the patient had died. In the afternoon two suspicious cases of Fever having been discovered in an adjoining hut, all the inmates of the block, which was a small one, were removed to Manicktollah, and the huts were disinfected and untiled."

Though this was probably not the first case that occurred in the town, I believe it to have been a very early one, as rat-mortality has generally been found to precede human infection by only about 8 days, and this is now so well known as a precursor of the disease that it could not have continued for long without being noticed.

In the course of the *post-mortem* examination it was noticed that one of the Domes, who assisted, had a bit of rag tied round his forefinger. On removing it a superficial cut nearly healed was seen and immediately cauterised. The other Dome, Budri, scratched his finger on a point of bone. We insisted on cauterising the place, though he protested that he had done *post-mortem* examinations daily for many years and frequently cut his fingers without being any the worse for it. They were both sent to Manicktollah to be kept under observation, and their cases will be referred to again. The following is the official report of the *post-mortem* examination made by Surgeon-Major Gibbons, dated the 21st April 1898:—

"On the 17th April, at 8 A.M., in the presence of Dr. Cook, Health Officer, at the Police Morgue, I examined the body of a native male, aged about 56 years, identified by Inspector B. B. Sinha, to be that of Issur Chunder Dey.

"The body was well nourished; *rigor mortis* present in all parts. There was a swelling in the left femoral region, and a swollen gland could be felt. The skin over the swelling was incised by Dr. Cook. Effused blood was found in the subcutaneous tissues and around a swollen lymphatic gland. The gland was enlarged and inflamed. Passing upwards from the gland in the groin and in the post-peritoneal tissues of the left side of the pelvis there was a large effusion of dark blood. There were large petechiæ on the liver. Serous effusion in both pleural cavities and in the pericardium. The surface of the heart was dotted over with petechiæ, and beneath the endocardium of the left ventricle there were two hæmorrhages of about the size of peas.

"The surface of the small intestine presented small, subperitoneal patches of hæmorrhage, and there was a large effusion of blood in the layers of the mesentery.

"Other organs and parts of the body were not examined.

"A careful examination was made of the left leg for any local inflammatory area. None found. The whole limb was incised, and the tissues appeared quite healthy except around the femoral gland.

"I am of opinion that the deceased died of an acute blood-poisoning, the nature of which can only be determined by bacteriological enquiry."

On Tuesday, the 19th April, some of the agar slopes made two days before from Issur Chunder Dey's case showed typical plague growths in pure culture. Two fresh tubes were inoculated from one of them and sent to M. Haffkine, and two guinea-pigs were inoculated in the subcutaneous tissue of the thigh with the culture. A flask of *bouillon* with *ghee* was also inoculated with the object of getting the stalactite test to confirm the other experiments. I may mention that microscropic preparations were made from the gland at the time of the *post mortem* examination and also from the cultures, and showed what appeared to be typical plague microbes, though not much importance was attached to this, as I am strongly of opinion that, in a question of such far-reaching importance as the presence of plague in a town like Calcutta, microscopic appearances alone should not be relied on for the diagnosis of plague. The inoculated guinea-pigs showed signs of being unwell on the second day, though they ate their food and moved about occasionally. On the third day they were seriously ill, and buboes were discovered in their groins on the side inoculated. On the fourth day they died within a few hours of each other. With the assistance of Dr. Dutt I made a *post-mortem* examination of them in the presence of Surgeon-Colonel Hendley and Surgeon-Major Dyson, who were closely following my experiments throughout the investigation. Both were alike. The femoral gland was more than double the natural size, deeply engorged and surrounded with extravasated blood. The organs were generally healthy except the spleen, which was somewhat engorged. A microscopic slide smeared with a piece of femoral gland and stained with fuchsine showed typical diplobacteria, and agar slopes which were inoculated developed the characteristic appearances of such cultures. Having thus obtained a likely clinical history and pathological, microscopical and cultural confirmation, I had no longer any doubt that we had to deal with genuine plague, but with the concurrence of Surgeon-Colonel Hendley and Surgeon-Major Dyson I deferred making an official report pending the receipt of a telegram from M. Haffkine giving his verdict. I had not long to wait, as on the evening of the 25th I received a telegram informing me that the specimens sent showed typical plague growth. Plague was not yet, however, officially declared. The death-rate of the town was below the average, and certain practitioners stated emphatically that the cases which were occurring were not plague at all, but a form of bubonic fever which was by no means uncommon in Calcutta at this time of the year and which sometimes ended fatally. So further references were made by Government to M. Haffkine.

I have described the case of Issur Chunder Dey as the first case of plague in Calcutta, as it was the first case reported to me, and the question whether there was plague in Calcutta depended in a large measure on the bacteriological diagnosis of the case. It is evident, however, that it was not really the first case. For I subsequently received the notes of the following cases which were treated in the Medical College Hospital from Surgeon-Colonel Bomford, the Principal Medical Officer. The clinical history of these cases taken in conjunction with the *post-mortem* appearances of the first leaves no room for doubt that these also were true cases of plague:—

"(1) Nasir Bukhsh, Mahomedan, Male, 27 years, of Baparitola, admitted on 30th March, 1898, suffering from torpor, great prostration, fever and enlarged axillary and inguinal glands on the left side. On 31st March patient became delirious, and temperature rose at 10-30 P.M. to 105·7° Fah. He died at 12-30, thirty-nine hours after admission.

"*Post mortem examination.*—Left inguinal and axillary glands much enlarged; on section spongy, red and greatly congested. Retroperitoneal hæmorrhages, hæmorrhages into wall of pelvis, of kidney and into the coat of the left ureter, numerous petechial hæmorrhages sub-pleural, sub-phrenic and sub-endocardial.

"(2) C. Perry, Eurasian, Male, 26, of 9 and 10, Kenderdine's Lane, admitted at 9 A.M. on 14th April, 1898, suffering from fever, temperature 104·2° Fah. The attack of fever commenced on the day before admission. On the evening of the day of admission the temperature rose to 105° Fah. and the patient became delirious at 9 P.M. On the 15th the temperature was 102·8° Fah. and patient quiet, but by 2-30 P.M. the temperature rose to 105° Fah. again. In the evening he was removed from hospital by his mother and brother, and it is reported that he died shortly after removal.

"(3) Babu Monmohun Chatterjee, Hindu, Male, aged about 25 years, a student of the Medical College, and residing with his family in Simla.* He was taken ill on 14th April, 1898, and was treated at his home by a native medical practitioner. He is said to have suffered from fever with some slight enlargement and tenderness of the left axillary glands. The temperature was high, 104° Fah. and 105° Fah. till 17th April, 1898, when the temperature fell and the patient became collapsed and died. This student had come into contact with patient No. 1, Nasir Buksh."

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* There is a street called "Simla" in Calcutta some distance to the north of the Medical College.

Possibly he carried the infection in his clothes, as he did not develop symptoms of plague till after the extreme incubation period.

Of the patients taken to Manicktollah on the 17th April from Kapalitola Lane, Pusan, aged two years and a half, was stated to have suffered from fever ushered in with a shivering fit from the 15th. His temperature on admission was 104·5° Fah., pulse 120, respirations 90. The following day a careful examination of his chest showed impairment of resonance of both bases, and râles were audible in both. His tongue was dry and coated. He became delirious, but subsequently developed the appearance of coma-vigil. As his facial appearance appeared to me to resemble that of plague, I made cultures from his *sputa*, but with a negative result. No bubonic enlargement was discovered. Before death his temperature reached 106. He died on the 20th, and no *post-mortem* was allowed. Though for want of such an examination there were not sufficient data upon which to base a definite diagnosis, I inclined to the belief that he had died of the pulmonary form of plague, and this belief was shared by Surgeon-Major Charles, and if I remember aright by Surgeon-Major Dyson. Other medical men who saw the case would not admit this probability, and held that it was a case of bronchitis.

Parbutty, aged 26, the mother of the above, was stated to have suffered from fever ushered in with shivering for five days. Her temperature on admission was 105° Fah., pulse 110, respiration 30. She had a distinct swelling, the size of a small hen's egg, in the anterior part of the left axilla behind the fold of the pectoral muscles. After two or three days' treatment she began to improve. The swelling suppurated and was opened on the 28th April. She was subsequently discharged convalescent. This case was diagnosed by two medical men of repute as influenza and as mammary abscess. Personally I had very little doubt that it was a mild case of plague, as the position and the feel of the glandular swelling appeared to me to be typical. I have never known of a case of influenza in which a glandular swelling occurred in that position, and a most careful examination revealed no abrasion of the nipple and nothing abnormal in the mammary gland, which was quite distinct from the swelling. The patient had weaned a child shortly before, and there was still some milk in the breasts. My opinion that it was a case of plague was shared by Surgeon-Major Charles and one or two other medical men.

Of the Domes, who assisted at the *post-mortem* of Issur Chunder Dey and were sent to Manicktollah to be kept under observation, it will be remembered that one had a healing wound and the other scratched himself on a point of bone. They were watched with the greatest interest, as it was thought that, if either of them developed plague, it would be a strong confirmation of the diagnosis that had been made in Issur Chunder Dey's case. The one with the healing wound escaped. The other, Budri Dome, aged 54, was found at noon on the 19th, two days after the *post-mortem*, to have a temperature of 102°, pulse 105. He complained of frontal headache, pains in the limbs and malaise. He was seen by the Medical Inspector in charge of the hospital to have a rigor. At the point of inoculation nothing was observed except the blackness of the skin, caused by nitrate of silver cauterisation. By night his temperature rose to 105·6° Fah. He had a dry and coated tongue, a harsh dry skin, congested eyes and a bounding pulse. The bowels were somewhat constipated. He was given a good dose of calomel and soda, which somewhat relieved the general symptoms, but left him much prostrated. On the 21st a swelling was discernible in the bend of the left elbow. The gland could not be distinctly made out owing to surrounding infiltration. The temperature that night went up to 105·4° Fah., after which it declined steadily, and the patient appeared to improve. The arm, however, became swollen and tense from the wrist to the shoulder. The arm was kept in bandages, wet with sulphate of iron, and the general swelling got less. By the 26th the temperature had fallen to 100° Fah., the patient appeared to be progressing favourably and asked for food. On the 28th suppuration having become evident, an incision was made, and 4 ounces of pus were obtained. By the 1st May the temperature was down to normal, the patient took nourishment well, and great hopes were entertained of his recovery. But on the 2nd it rose again to 100·2°, pulmonary symptoms set in, and the patient coughed up about an ounce of frothy blood in the evening. He gradually sank, and died on the morning of the 3rd, fourteen days from the commencement of the attack. Budri's case was closely watched by a number of medical men, and opinion was about equally divided, some holding that it was ordinary septicæmia, and others that it was plague-septicæmia. Taking into consideration the fact that he had done a large proportion of the *post-mortems* at the Medical College for fifteen years and had been known to have repeatedly cut himself in the most purulent cases, such as acute peritonitis and the like, without taking any precautions and without experiencing any bad effect, I came to the conclusion that he must be to a considerable extent immune against coccal infection. Moreover, the culture tubes inoculated from the cadaver from which he was infected gave pure plague cultures free from impurities. Besides, the clinical features of the case appeared to me to be rather those of plague than ordinary septicæmia. Unfortunately, no *post-mortem* was made. Budri was a drunkard and a very popular character among the Domes, and though it was their business in life to cut up others, they absolutely refused to let their friend be cut up. They came down in considerable numbers and carried him off to the burning-ghat. During the period under report 4 other Domes contracted plague after doing *post-mortem* examinations, but I have no particulars of their cases as they were not treated in Municipal Hospitals, with one exception which was decribed as follows by Surgeon-Captain C. Green in the *Indian Medical Gazette*:—

"The case which came under my observation was in another of the Domes, named Sukhu and aged 35 years. He assisted at the *post-mortem* examination of a case of plague that died at the Campbell Hospital of Calcutta on 3rd June, 1898. This was an undoubted case of plague.

"On the morning of June 8th, I was informed that he was very ill. I found him in his quarters with a temperature of 103·5° Fah., heavy and stupid in his manner, eyes suffused and a dry tongue. There was an enlarged gland in the left axilla, the size of a small hen's egg, that was tender on pressure but moveable. He was said to have had fever two days. He was removed to the isolation ward. On 9th May his temperature was 106°, the pulse small and weak. The gland in the left axilla had increased greatly in size, and from inflammatory exudation it was more fixed and its limits obscured. He was unconscious and could not be roused, but restless and tossing about so much that, to prevent his falling off the bed, two beds were joined together, and the patient placed in the middle. He died at 5-30 P.M. on 10th May. This man was at first stated to have cut his finger at the time of making the *post-mortem*, and, on examination, there was a small nearly healed cut on the *right* thumb, but no wound or abrasion was found on the left upper extremity, although the axillary glands were affected on this side.

"In the case of Budri, the symptoms commenced two days after the *post-mortem*, in Sukhu's three days apparently, and in the case recorded by Surgeon-Captain Prall, two days after inoculation."

I have given a *resumé* of the above cases as showing what has almost invariably taken place, that at the beginning of an outbreak there are a number of cases which are difficult to diagnose, and that the medical men who see them are unable to agree about their nature. Had it not been for the *post-mortem* appearances and typical plague cultures from Issur Chunder Dey's case, I could not myself have said that Pusan, Parbutty and Budri were plague cases, though I should have regarded Parbutty's case as extremely suspicious. Of the other contacts none developed plague; so they were discharged after ten days' segregation.

On the 20th April another case occurred in Kapalitola Lane, a Hindu, aged 14, who was taken to the Medical College and died there, and on the following day a Eurasian female, aged 42, was taken there from Kenderdine's Lane in the same ward, and died. No cases were reported on the 22nd or 23rd. On the 24th the following occurred:—

No.	Name.	Age.	Sex.	Caste.	Ward.	Address.	Result.
9	Shaik Etwari	35	M.	Mah.	13	13, Market Street	Died.
10	Kamini	30	F.	Mah.	13	13, Market Street	Died.
11	Meando	22	M.	Hindu	13	1, Municipal Office Street	Died.
12	Ram Kissen	10	M.	Hindu	13	1, Market Street	Died.
13	Chuni	10	M.	Hindu	10	10, Kapalitola Lane	Died.
14	F. Francis	14	F.	Eurasian	10	11, Kenderdine's Lane	Died.
15	Bridjoo	35	M.	Hindu	8	5, Tarachand Dutt's Lane	Died.

The disease thus began to show signs of spreading. Two of these cases occurred in places already affected, Kapalitola Lane and Kenderdine's Lane, four in a new quarter, the neighbourhood of the General Market and Municipal Office, and one in Tarachand Dutt's Lane, which is not far from the place of the first appearance. Champa, a native Christian, appears to have been the connecting link between Kapalitola and the market area. She was said to have resided near 11, Kenderdine's Lane, till a day or two before her illness when she removed to New Market Street, where her illness commenced. She was taken to the Medical College Hospital, where she died. Shaik Etwari was found delirious in a bustee hut lying on the same bed with a dead woman, Kamini, a prostitute, who had only just died, for her body was still warm. In his delirium the sick man pushed the dead woman off the bed, and she fell with a thud on the earthen floor, where she lay doubled up. A crowd of neighbours had collected round the door and stared horror-struck at the sight, but none volunteered to move her. This was the first glimpse I had of the horrors of plague. As the woman had a well-marked axillary bubo, I went to my laboratory for culture tubes and appliances, and made cultures from the fluid in the gland, which I obtained by means of a capillary glass pipette after cauterising the surface. From these cultures I subsequently obtained the plague bacillus in pure culture. The fact of these two persons being taken ill so suddenly as they had been seen about the day before, the woman smoking her *hookah*, gave the Police the idea that there might have been foul play, and I was not sorry to take advantage of this to get a *post-mortem* examination, as it was by no means generally accepted even by the medical men in the town that the cases that had gone before were plague. The *post-mortem* was done by Surgeon-Major Gibbons in the presence of Surgeon-Major Dyson and myself. The gland was found enlarged, purple softening in the centre and surrounded by hæmorrhage extending down to the lower ribs. Nothing could have been more typical of plague. Shaik Etwari was placed in the horse ambulance and taken to Maniktollah Hospital, which he was not expected to reach alive. However, he rallied and made a great fight for life, though he finally succumbed 10 days after admission. He had a typical femoral bubo. On the 25th April two cases were reported, one a Muhammadan living in Bhowani Churn Dutt's Lane, the other a Hindu Durwan living on the premises of Messrs. Kilburn and Company, 4 Fairlie Place, Strand. The former was taken to the Medical College Hospital and died on the following day. The latter was found dead on the premises, which were very near the East Indian Railway Company's and British India Steam Navigation Company's premises, where dead rats had been found. This was the first human case in the quarter, and a very thorough disinfection of all the godowns was made.

On the 27th April seven cases were reported, four of them occurring in the market area, two in the area first infected, and one in Ezra Street, Ward 7, where dead rats had been found. Two were Hindus, two Muhammadans, two East Indians, and one unknown. Three were taken to the Medical College Hospital and three to Manicktollah.

On this day the Chairman called a meeting of the Commissioners to consider the situation. There was a good attendance. The Chairman suggested the formation of Vigilance Committees by the Ward Commissioners with power to add to their numbers, which was put into the following Resolution, proposed and seconded by Mr. Simmons and Dr. Wallace, and carried :—

"That a Vigilance Committee be formed in each ward consisting of the two elected and one nominated Commissioner assisted with the leading men in each ward to carefully inspect the ward and report as regards unusual dirt, faulty drains or sanitation and cases of suspicious sickness or death, and to make suggestions for other sanitary improvements."

About this time dead rats began to be noticed in considerable numbers in the General Market, in the neighbourhood of which human cases had been occurring, and were found on investigation to have died of plague. The entire market was very thoroughly disinfected, coolies being put on and working in shifts night and day. In this area human cases were discovered before rodent, but although I have quoted Champa as having introduced the disease into this quarter a week before, I think from the way the disease appeared amongst different classes all round this quarter and the suddenness of the onset, that it is much more probable that infection of rats came first, though it was not discovered till after several cases had occurred. As many as nine rats were found dead in one basket under a stall in the market. About the same time a bustee in Korabardar's Lane, where cases had occurred, was cleaned out and disinfected..

On the 29th April eight cases were reported, three from the market area, and the remainder scattered over Wards 1, 2, 7, 8 and 20. On the 29th there were three cases, two of them occurring in the market area, the third, a very doubtful one, was sent by a cooly doctor to the Manicktollah Hospital from Garden Reach, Ward 24, kept under observation for ten days, and discharged.

By this time the Press and Public were clamouring to know whether there was plague in the town, or only a severe form of bubonic fever common in Bengal, as some practitioners alleged.

On the 29th His Honor Sir John Woodburn and the Hon'ble Mr. Risley took advantage of their inspection of the Eden Hospital to meet their own medical advisers and a few other medical officers who had seen the cases in Calcutta and had some experience of plague elsewhere. His Honor read out a second telegram from Mr. Haffkine confirming the first one and asked everyone present his individual opinion, whether there was plague in the town or not. Every one answered in the affirmative. His Honor then said that in view of the very low death rates prevailing in the town and for other reasons he had been loath to believe that the plague was among us, but with Mr. Haffkine's positive pronouncement and the collective opinion of the gentlemen present before him, he now accepted the situation and should declare the presence of plague and the policy of Government at the Council Meeting on the following day. In the meantime he pledged all present to secrecy.

The meeting was held in the morning, and though I believe that everybody kept his promise of secrecy, all the reporters were busily instituting inquiries, and it became known that His Honor had held a conference with his doctors. By noon the excitement in the town was intense. In business houses and in bazars, streets and bustees the question was discussed, had the dreaded Bombay plague come at last, were their houses going to be forcibly entered, and their wives and daughters torn away by British soldiers, was quarantine to be established, and were they all to be forcibly inoculated? The result of this was one of the biggest panics on record. It could hardly have been greater if the announcement had been made that a hostile force had defeated the British and was advancing on the town. "There is only one remedy against the plague," wrote Defoe, "and I give it as a prescription, and that is, to run away from it." It will be seen that this ancient prescription found favour among the public of Calcutta, and with what results, though it was plague measures rather than plague that they fled from. A greater number of people had left the town on the 28th and five hundred people had been refused tickets at Howrah Station, but on the 29th and 30th there was a regular stampede by rail, river and road. Men and women left their houses with hardly any preparation, in many cases not knowing where they were going. The *gharri-wallahs* charged six to ten rupees for a six-anna drive, and *palkis* were not to be had for any money. Women, who had never left the *zenana* except in closed carriages or *palkis*, now made their way on foot to the station. Howrah Bridge was blocked, and the station besieged by one continuous crowd. As special after special came up to the platform, many of them composed of goods waggons, there was a frantic struggle for places. Bengali Babus got their light muslin clothes torn off their backs, and several people died in the crush. Hour after hour this went on. The sufferings of the crowd were intense. Once in, it was impossible to leave it, and it was quite impossible to supply such a crowd even with water. Rich and poor suffered alike, and money would not procure any alleviation. The Police and Railway officials did all they could in regulating the passenger-traffic, but no organisation could have coped with such an immense and panic-stricken mob. Of those who got away safely many had no place to go to, and people who had never before passed a night out of doors, wandered about the country and camped under the trees. It was generally estimated in the town that from a quarter to a third of the population left. From a comparison of the number of deaths from all causes with the average number it would appear that the former figure was about correct.

At the meeting of the Bengal Legislative Council on Saturday, the 30th April, the existence of plague in the town was publicly announced. In answer to questions put by the Hon'ble Messrs. Surendro Nath Banerjee, Norendro Nath Sen and Turner with regard to the suspected outbreak of plague in Calcutta, the Hon'ble Mr. Risley, Secretary to Government, Financial and Municipal, made an important statement. After describing all that had occurred, he made the following announcement of the measures to be adopted in Calcutta :—

The measures to be adopted in dealing with an outbreak of plague are stated briefly in Chapter XVI, "Report on the Plague in India, 1896 and 1897," recently published by the Government of India. They are the following :—

(*a*) The prompt detection of cases by carefully enforced death registration, house-to-house visitation and such other means as are found practicable.

(*b*) The segregation of the sick and their careful nursing and treatment in well-ventilated and sanitary hospitals.

(*c*) The segregation after disinfection of clothing, bedding, etc., under medical supervision and in sanitary surroundings of the persons who, by association with the sick, have been specially exposed to the risk of infection.

(*d*) The evacuation of infected houses and localities, the inmates being lodged in carefully supervised health camps.

(*e*) The thorough cleansing and disinfection of infected houses and localities before the inmates are permitted to return.

(*f*) The enforcement of general sanitary precautions, such as extensive cleansing of dwellings, free admission of light and air, destruction or modification of insanitary buildings, improvement of drainage and conservancy, abatement of overcrowding, and opening out of congested localities.

Plague Notification No. 9 of the 10th November, 1897, gives effect to these principles in Calcutta, but mitigates them in the case of the upper classes by providing in rule 46 for the formation of private hospitals and segregation camps subject to the necessary precautions.

With regard to inoculation he said that the Government consider that the inoculation of the inmates of an infected house cannot take the place of the evacuation of the house which is essential for the purpose of disinfection. They held that the inmates of an infected house may be given the option of being inoculated instead of being removed to an observation camp for the full period of inoculation; but after inoculation it will be necessary to keep them in a segregation camp during the course of the inoculation in order that they may be properly sheltered and kept under medical surveillance. As soon as the process of inoculation is over, they may be released from segregation. The Government of India also consider that the inmates of houses round an infected house may, if they submit to inoculation, be exempted from both evacuation of the houses and segregation of their inmates. These concessions do not affect the treatment of persons actually suffering from plague in uninoculated households, who must be segregated either in public or private hospitals. But now that the efficacy of the Haffkine virus has been demonstrated, the experiment will be tried of exempting all families, which have been entirely inoculated prior to the occurrence of any case of plague among them from liability to segregation. That is to say, if a member of a completely inoculated family is attacked by plague, neither he nor his family will be liable to removal to a segregation camp. This privilege will be subject to the strict provision that any case that may occur in the family must be reported to the Health Officer within twelve hours of the patient falling ill, and that the directions of the Health Officer as to the isolation of the patient within the house and daily disinfection of all parts of it, are faithfully carried out. The Lieutenant-Governor wishes it to be distinctly understood that while on the faith of the experience in Bombay, he strongly commends the method of inoculation to the people, inoculation will be pressed on no one. Every man will be left entirely free to satisfy himself of its efficacy and of the propriety of asking for it in the circumstances of his own household. Every assistance will be given to those who do apply, but the matter is left absolutely and entirely to the discretion of the people themselves.

His Honor the Lieutenant-Governor made the following speech, which created an excellent impression on all present :—

"Gentlemen, to the very clear and calm statement which has been read to you by the Hon'ble Mr. Risley, I think it is desirable that I should, on an occasion so important, add a few words of my own.

"You have heard that not till yesterday were we able to say whether the dropping cases which have occurred during the last ten days were or were not plague. It is, alas! now certain that they were plague, and, as was our duty, we have told you frankly and at once. But I want you to take courage and give courage to those whom you represent and influence.

"You know now that in a population of 800,000 people there had been only the absolutely infinitesimal occurrences of a couple of dozen cases in ten days. They are few and sporadic and every one has been dealt with as it occurred with the entire precautions that the plague rules require. We think therefore, we may assume that the plague has been taken, fairly and in time. We have had the immense advantage over Bombay in 1896 that we were on our guard, and that the plague had not established itself before it was recognised. It has come at a time of the year which is the least advantageous to the spread of it, and in a season which, as the Hon'ble Mr. Risley has told you, is exceptionally healthy. There is, therefore, every reason to hope and believe that we shall succeed in preventing the plague from assuming an epidemic form, and in all the encouraging features for the case no sensible person will feel the smallest ground for alarm. I am sure you will all join with me in circulating to your constituents this consoling and re-assuring character of the case.

"In another and very important matter I will ask you to give your aid in reassuring the people: whenever segregation is necessary it will be carried out with the strictest regard to the feelings of human nature. No wife shall be separated from her husband, no husband from his family, and the better classes will receive encouragement in the arrangement of private hospitals in their own compounds or in garden-houses in the suburbs, to which they can remove themselves and their families in case of attack.

"In addition to all these mitigations of the Bombay rules, we have announced to you to-day the scheme of a new method. Inoculation, I repeat, will be pressed on nobody. In this method, in which, when once you have assured yourselves of its efficacy, lies, I am satisfied, the assurance of safety to our city. I have made a great experiment. We have intimated to you that where families have been completely inoculated, we will leave them alone, even if plague attacks a member. It is a risk, but a risk worth running. We accept it, because we believe the inoculated patient will have the very mildest form of attack, and will not be a material danger to his family or neighbours.

"The policy of segregation is a policy of painful necessity, the policy of inoculation to you is at least, and for the first time in the great battle with plague in India, a policy of hope.

"Therefore, it is, gentlemen, that I bid you be of good cheer. Our plague is meanwhile a mere tiny business for which we have made the most careful preparations, and which we hope to keep a tiny business. But should it be otherwise, we start our battle under conditions and with methods which give us assured hopes of such a victory as has not been won in India.

"I am told that large numbers of people are leaving Calcutta under the apprehension that quarantine is about to be established. They may be reassured there is no such intention whatever."

The speeches of the Lieutenant Governor and the Hon'ble Mr. Risley had a very reassuring effect, and much was said and written about the benign policy of Government. To allay the panic amongst the ignorant classes who do not read the daily papers, the following announcement was drafted in the Municipal Office as soon as the Legislative Council Meeting was over :—

"Quarantine will not be enforced by Government against Calcutta.

"No segregation will be enforced if the entire household has been inoculated.

"No one will be declared plague-stricken without being seen by a competent medical officer, male or female, deputed by the Municipality.

"No one will be separated from his or her family. If necessary, all will go together to a camp, where the *purdah* will be respected.

"Compensation will be paid on the spot if any property is destroyed in being disinfected.

"Encouragement will be given to the public to provide private family hospitals for the treatment of their relatives in their private houses, where proper accommodation is obtainable.

"No person will be removed except on the order of a medical officer. The Police are not authorised to examine or remove anyone."

This was speedily translated into the vernacular, printed on slips, and distributed, and also publicly cried through the town with beat of tom-tom. This, no doubt, had on the whole a good effect, though it was somewhat marred, as some of the criers were heard giving out their own version, which was quite different from the Chairman's.

On the 30th April six cases of plague were reported, four of them from the market area, one a Jewess from Ezra Street, where dead rats had been reported, and one from Ward No. 8. This makes the total to the end of the month 41, which were distributed as follows by weeks:—

April	14th to 20th . .	7 cases.
Do.	21st to 27th . .	17 ,,
Do.	28th to 30th . .	17 ,,

This shows that up to this time the outbreak was distinctly progressive, the number of attacks reported in the second week being nearly two and a half times the number in the first, and the number of attacks in the three days at the end of the month being equal to the number in the week preceding. This concludes what I regard as the first or introductory period of the epidemic, from the discovery of the first case to the public announcement of plague and plague policy by His Honor the Lieutenant-Governor in Council. I may further mention that on Saturday, the 30th of April, the first inoculations with Haffkine's prophylactic were performed on some of the staff, nursing sisters and menials at the General Hospital, some of whom had been exposed to infection from a case which had been admitted there.

After the announcement that the city was infected by plague the reported cases were noticeably fewer, only four occurring during the week ending 7th May, eight during the week ending the 14th, seven the week ending the 21st, and seven the week ending the 28th; thirty-two in all in the month of May. This may have been due to seasonal conditions, May being the hottest month of the year. Possibly the withdrawal of Police assistance in the discovery of cases had something to do with it. Previously the Police had been of the greatest assistance in the discovery of cases, but their activity aroused a strong protest in the newspapers, in consequence of which they ceased making special inquiries. In June there was a slight increase in activity, 77 cases being reported, and in July up to the 22nd, when I handed over charge, there were 38 cases reported.

The period following the announcement of plague was characterised by organisation on the part of the authorities, panics, strikes and disturbances amongst the lower classes of the people. Ambulance parties were attacked, the white Bombay ambulance being a particular *bête noire*. It was rumoured that something was put to the noses of the patients in the ambulance and that they died after smelling it: also that there was a poisoned needle concealed in it which killed them. On one occasion, 12th May, an ambulance was burnt in College Street after being saturated with kerosine oil. The ringleaders were subsequently apprehended and are now expiating their afternoon's amusement in jail. A repetition of the occurrence was prevented by sending the ambulances under a Police escort armed with *lathies*. A most unfortunate occurrence was the beating to death of a young Austrian, who was carrying a hand-bag, which aroused the suspicion of his being an inoculator. Another was the attack on Dr. S. R. Laing, a District Medical Officer, who had gone to the house of a native Pleader at Bhowanipur, at his request, to inspect it for a private family hospital. The mob broke into the house in spite of the Pleader's assurances, and Dr. Laing had to shoot two of them in self-defence. On Sunday all the butchers in the New Market struck work, and not an ounce of butcher's meat was procurable. They were subsequently induced to come back, but only kept together with great difficulty by Mr. Jones, the Superintendent, in whom they had considerable confidence. The entire trade of the town was for a time almost at a standstill for lack of labour, and many households were seriously inconvenienced for want of domestic servants.

The following Medical Officers were appointed on special plague duty, and with the exception of Dr. E. C. Pettifer, who assisted in the Office, had charge of disinfection, and acted as visiting physician to the Manicktollah Hospital, and Dr. Christie, who was principally engaged in inoculation, were placed in charge of Districts: Drs. E. C. Pettifer, W. A. Justice, S. Nariman, J. Stevens, H. D. N Mackenzie, F. G. Clemow, W. C. Hossack, S. R. Laing and Margaret Traill Christie. All except the first were officers, sent out from England on plague duty, whose services were lent by Government to the Chairman of the Corporation. Dr. E. W. Chambers, late Coroner of Calcutta, and Dr. Ayatulla were appointed locally, the former on account of his local knowledge, and the latter on account of his caste, which enabled him to go about freely amongst the Muhammadans, his fellow caste men. Mr. Lloyd and Mr. Catania, Military Assistant Surgeons, were placed in charge of the Manicktollah Hospital and Dr. Lahiri, a Brahmin Food Inspector, was associated with them. Some extra Medical Inspectors were also appointed to assist the District Medical Officers. Three nurses were appointed locally, and seven were transferred from Bombay.

At the same time that the Executive was organising its forces, the Commissioners were busy forming Vigilance Committees in the Districts and Ward Committees in all the Wards whose duties were to make house-to-house inquiries as to the health of the people and report suspicious cases, to establish ward and caste hospitals, and report any serious sanitary defects. Military officers were appointed to assist the District Committees. The Committees mostly worked well, but they failed to gain the confidence of the people, who concealed cases from them almost as much as they did from the Executive. As they had no power of entry, they could only accept what they were told. So the net result of their arduous and disinterested labours was somewhat disappointing so far as the detection of cases was concerned.

The Manicktollah Hospital was the first ready for use. It consisted of a large, two-storeyed building in a spacious compound, in which thatched sheds for observation cases and quarters for contacts were erected. It was an excellent hospital for the purpose, but had the drawback of being rather far from most parts of the town. There was the further disadvantage that Manicktollah is a Golgotha of Calcutta, a place of burial, and that to say of a man "He's gone to Manicktollah" is equivalent to saying, "He's gone to his last resting-place." The high mortality amongst the early plague cases taken to this hospital supported this idea, and the consequence was that to suggest sending a patient to Manicktollah was almost enough to frighten him to death if he were conscious, and that the ignorant people did all in their power in the way of concealing cases and mobbing ambulance parties to prevent us sending their friends and relatives to what they considered so undesirable a place. Independent persons who visited the hospital reported most favourably on it, however, and it was said to be the best hospital of its kind in Bengal. Two other plague hospitals were constructed on a plan drawn up by the Inspector-General of Civil Hospitals and the Sanitary Commissioner, one in Marcus Square in the centre of the town, the other in Budge-Budge Road in the suburbs on the south. On account of the danger of incendiarism, on the suggestion of His Honor the Lieutenant-Governor, they were made almost entirely of corrugated iron. Neither of them was used during the period covered by this report. A camp to hold 300 contacts was commenced in Narkeldanga Road not far from the Manicktollah Hospital, but was not completed.

The licensing of roofs and upper storeys of private houses of the better class, as family hospitals for the isolation of the residents, was commenced by the Plague Commission before the appearance of the disease, and was subsequently transferred to the Chairman of the Corporation. A large number of applications were received, and the necessary inspections threw heavy work on the District Medical Officers. The ward and caste hospitals I invariably inspected myself before recommending them for sanction. There was considerable difficulty in obtaining suitable houses in some parts of the town on account of the small size of the rooms and narrow winding staircases in the majority of native houses. The latter difficulty was in some cases got over by constructing a broad wooden staircase from the courtyard which formed the centre of the block of buildings. These hospitals were as a rule fairly equipped with hospital necessaries, and were provided with more or less skilled nurses. They were in charge of local practitioners, but any patient could be treated by his own doctor, whether orthodox or heterodox. The entire cost of these hospitals was defrayed by voluntary subscriptions raised by the Committees. In some wards the better class people showed great liberality in subscribing. A number of better class Muhammadans, wishing to make provision for their families, subscribed, and took a spacious house at 57, Jhaotola Street, and converted it into a joint family hospital. Mr. Abdur Rahman initiated the idea, and did much towards carrying it out. The following is a list of the Ward, Family and Caste Hospitals :—

List showing the number of Ward Hospitals licensed in each ward, the locality and the nature of the accommodation provided up to 22nd July 1898.

No. of Ward.	WARD HOSPITALS LICENSED.		
	Locality.	Accommodation provided.	Date of opening.
I	100, Sham Bazar Street . .	For ten or twelve patients .	8th July, 1898.
II	50, Nanda Ram Sen's Street .	„ twelve or thirteen patients .	16th July, 1898.
III	63, Beadon Street . . .	„ eight patients . . .	8th July, 1898.
„	252, Circular Road (Upper) .	„ eight patients . . .	8th July, 1898.
IV	....		
V	....		
VI	....		
VII	....		
VIII	80, Tara Chand Dutt's Street .	„ eighteen patients . .	25th June, 1898.
„	17, Eden Hospital Street . .	„ twelve patients . . .	25th June, 1898.
IX	....		
X	....		
XI	....		
XII	....		
XIII	109, Jaun Bazar Street . .	„ twelve patients . . .	20th July, 1898.
XIV	....		
XV	....		
XVI	....		
XVII	....		
XIX	26, South Road Entally . .	„ twenty-five patients . .	11th June, 1898.
XX	162, Kurrya Road . . .	„ six patients . . .	22nd July, 1898.
XXI	....		
XXII	....		
XXIII	....		
XXIV	....		
XXV	....		
TOTAL .	9	„ 114 patients.	

List showing the number of Caste Hospitals licensed in each ward, and the locality and accommodation of each up to 22nd July 1898.

No. of Ward.	CASTE HOSPITALS LICENSED.			
	Locality.	Caste.	Accommodation provided.	Date of opening.
I				
II				
III	4, Kartick Bose's Lane .	Baidya . . .	For eight patients .	21st June, 1898.
IV				
V	12, Banstola Gully .	Marwaris . . .	„ thirty-two patients .	20th July, 1898.
VI				
VII	96 and 97, Lower Chitpur Road.	For Saravat, Khetri and Brahmin. 27th July.	„ ten patients . .	22nd July, 1898.
TOTAL .	3	......	50	

List showing the number of Family Hospitals licensed in each Ward up to 22nd July 1898.

Ward.	
1	70
2	44
3	110
4	52
5	45
6	82
7	42
8	112
9	101
10	38
11	*Nil*
12	66
13	17
14	7
15	2
16	*Nil*
17	2
18	*Nil*
19	4
20	12
21	12
22	44
23	*Nil*
24	*Nil*
25	2
TOTAL .	878

Special gangs under Disinfecting Inspectors were sent to cleanse and disinfect houses where cases occurred. The usual methods were adopted—(1) to thoroughly spray the floor and walls with corrosive sublimate and acid made according to the Local Government Board formula, for which hydronets were found most useful, wooden buckets being used to hold the solution ; (2) to remove and burn outside rags, mats and bedding ; (3) to lime-wash, and (4) where practicable, to remove a portion of the tiles. The Equifex Steam Sprayer was largely used at first with phenyle but it was found to be inconvenient to transport and to attract too much attention. Wooden Chinese pumps were ordered before plague appeared, but were not received until after the period of this report. A full-sized Equifex Steam Stove had been purchased some time before, but it was not available for use during the period under review, as the shed for it was not completed owing to the difficulty of obtaining labour at the time.

The following instructions were printed and circulated through the Ward Committees :—

HINTS TO HOUSEHOLDERS.

"The plague infection breeds best in dark and damp places. It is advisable therefore to open up all dark places and to see that all water used for domestic purposes runs off by the drains and does not stagnate in the basement of houses, which should be kept scrupulously clean.

2. " The infection of plague is frequently carried from house to house by diseased rats which run over the floors, mats and grain-bags at night. If dead rats are found in a house, people who are in a position to do so should leave it and have it disinfected. If not, the floors should be sprinkled with a disinfectant *before* being swept. Mats, rags, grain-bags and other articles, likely to carry the infection should be put out in the sun for two hours every day. Dead rats should not be touched by the hand; they should be burnt outside the house.

3. " It has been found in Bombay and elsewhere that in the hot weather, when people of the poorer classes sleep mostly out of doors, comparatively few cases of plague occur among them, but when they have to pass the night in overcrowded sleeping-rooms, the disease is apt to spread rapidly. The doors and windows of sleeping-rooms should therefore be kept open day and night, and the ventilation, if it is insufficient, should be improved. There is less danger of infection in sleeping on a cot than on the ground.

4. " Plague is frequently contracted through cuts and abrasions. Any broken surface of the skin should therefore be washed with a disinfectant, and protected with a healing ointment. Any one attending on a plague patient should wear shoes and wash his feet and hands with a disinfectant before leaving the room.

5. " Privies and drains should be kept clean and any damp places should be daily sprinkled with chloride of lime. There is no necessity to pour large quantities of disinfectants down drains, as plague is not a disease specially connected with sewers and drains.

6. " As regards the better classes, there is no need to comment on the importance of personal cleanliness in the preservation of health. It would be well if they insisted on their servants and dependants keeping their persons and clothes scrupulously clean.

7. " Amongst the better classes there is not so much danger of the plague appearing in the first instance at any rate, amongst the members of the family as amongst their servants. As far as possible, servants should not be permitted to reside in bustees or other insanitary dwellings, but should be required to live on the premises. Their quarters should be daily inspected by the head of the household and should be kept scrupulously clean. Servants should be provided with cots to prevent their sleeping on the ground.

8. " In the event of any illness occurring in a household, the family doctor should at once be sent for, and if he thinks the case suspicious, information should forthwith be sent to the District or Ward Office."

The conservancy of the town was a matter of great difficulty owing to panics and strikes amongst the coolies. On the 27th April the whole Conservancy Department was transferred to the Engineer by a Resolution of the General Committee of the Commissioners, which was given effect to on the following day. On the 4th May a partial strike occurred among the conservancy coolies of Wards 8 to 11 to the extent of about 60 per cent., and the muster-rolls of Wards 12 to 17 showed that the number of absentees in those was unusually large. The men resumed work on the 6th, though the number of absentees was still more than usual. On the 20th a strike occurred amongst the mehtars in Wards 4, 6, 8 and 9, and on the 21st a general strike in all the wards, which lasted till the 23rd and caused the greatest inconvenience, as a considerable portion of the town is still dependent on them for the removal of night-soil, and no one else can be got to do their work. They returned to work on the 23rd and were given a ticket promising them that they should not be removed to any public hospital. It was proposed to get over the difficulty by erecting hospital sheds for them in the vicinity of their bustees. On the 17th June the conservancy was re-transferred to the Health Officer by a Resolution of the General Committee. The attendance of coolies during the month was still bad, the absentees averaging about 40 per cent. In July the attendance was almost up to the normal again, but the cleansing of the town was far from satisfactory and was the cause of much complaint, which was partly due to he inefficient manner in which the cart contracts were carried out. My proposals for the improvement of conservancy, which were in abeyance whilst the Department was under the Engineer, were again taken into consideration by the Commissioners.

The following is a statement of the plague cases treated in hospitals :—

The cases in the Manicktollah Hospital were nearly all of the bubonic or septicæmic types. In some reports on plague the distinction appears to be made that in bubonic cases only one gland or set of glands and their immediate vicinity are affected, and in the septicæmic either no glands or a number of glands in different parts of the body. I should take it to be more in accordance with what we know of other diseases to say that the disease was bubonic so long as the microbes were confined to a circumscribed area, but septicæmic when they were present in the general circulation. Taking it in this sense a bubonic case frequently becomes septicæmic before death, as is not uncommon in diphtheria, a somewhat analogous localised bacterial disease, and without making cultures, or at any rate microscopical preparations from the blood, it is often, I believe, impossible to say whether a case is bubonic or septicæmic. The treatment adopted was generally ice to the head and to the buboes, though sedative applications, such as belladona and glycerine, were used more for the latter. Surgical relief was given in three cases of suppuration. Tepid sponging was resorted to in cases of high fever. A purgative, such as calomel and soda, was frequently given on admission. Stimulant medicines, such as ammonia and strychnine, were largely used, and cardiac tonics, such as strophanthus and digitalis. Stimulant and diaphoretic mixtures, containing acetate of ammonia and nitrous ether were frequently administered. In cases where symptoms of cerebral excitement were prominent, sedatives, such as morphia hyoscyamus and bromide potassium, were given. Tonics, such as quinine and iron, were given in convalescence. Relatives were admitted to the hospital and allowed to assist in the nursing of the cases. Alcohol, generally rum, and meat-soups, which form most valuable adjuncts to medical treatment in cases like plague, where the greatest danger is death from cardiac syncope, could only be given when there was no caste objection. The resident medical officers were strictly enjoined to respect the caste restrictions of their patients as will be seen from the following rules :—

RULES FOR RESIDENT MEDICAL OFFICERS OF PLAGUE HOSPITALS.

(1) You will, at your discretion, show any respectable person over the hospital, and let him see the general arrangements.

(2) You will permit medical men to see the patients if they are in such a state that a medical examination would not harm them.

(3) You will allow one or two relatives to remain in attendance on patients.

(4) In the case of natives of India special care must be taken to give only such diet and stimulants as are permitted by religion and caste. Hindus are not to be given soups unless it has been ascertained that they do not object. Soups may only be made of mutton, goats' flesh, or chicken. Alcohol is not to be ordered for such Hindu castes as object to it, nor in any case for Muhammadans. Non-alcoholic stimulants can be used in such cases.

(5) You will keep your clinical records locked up and will not show them to any one without the Health Officer's permission. They should form a complete record of the cases.

The vital statistics for this period are curious. Commonly, though by no means invariably, when an outbreak of plague occurs, the mortality is found to be above the normal, but the accompanying chart shows that in Calcutta it was much below the mean, averaging 15·6 per cent. below it. The chart has been constructed by taking the mean of five years for each week, and the percentage of mortality above and below it, so that the mean would not properly be represented as a straight line, but it has been so represented to avoid complication. This low mortality is due to the exodust. It is computed that at least 150,000 persons left the town, and that 50,000 were still absent at the end of the period under review. If we take the mean number absent as 100,000, or 16 per cent. of the population according to the census of 1891, namely, 681,560, we find that the percentage of persons absent was 0·4 higher than the reduction in the mortality. This small difference would more than disappear if the calculation was made on the estimated population of 1898, so it is evident that the mortality was not at all below the normal. The births were 24·4 per cent. below the mean which is very much more than the deaths. This is accounted for by the fact that a proportionally larger number of women, especially of women who expected to be confined, left the town. The fact that they took their infants with them would also tend to lower the death-rate, as the mortality amongst infants is much greater than among adults. It is also rumoured that people left the town if they developed symptoms of fever, though I am unable to say whether they did so in sufficient numbers to appreciably influence the mortality. Another noticeable feature in the vital statistics is the large reduction in deaths registered under fevers and the increase under "all other causes," namely, 45 and 24 per cent. As the reduction in the total mortality was 15 per cent. below the normal, the real reduction under fevers would only be 30 and the increase under "all other causes" 39. The figures do not exactly correspond, probably owing to some other factor which I have overlooked, but there can be no doubt that a large number of deaths, which would ordinarily be registered under fevers, were registered under "all other causes," and that the reason for this was the fear that the officers of the Health Department would make inquiries and disinfect the houses where suspicious cases of fever had occurred. Such deceits and subterfuges have occurred wherever plague has appeared and whatever measures have been adopted. It was hoped that when the agency for detecting cases was composed of chosen representatives of the people themselves, the people would voluntarily report their cases, but they do not appear to have done so as a rule up to the present time, and the Vigilance Committees have had great difficulty in detecting cases.

A glance at the accompanying spot-map will show that most of the cases occurred in the middle of the town in an area comprising Wards 7, 8, 10 and 13. The north, south and east of the town were practically free. The following table gives the distribution according to wards as it occurred week by week :—

Name of Wards.	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22		23		24		25		Unknown.		Total.	
Week ending—	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d	s.	d	s	d.	s.	d	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d	s.	d.	s.	d.				
14th April to 16th April	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...		...	...	2	2	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3
April 23rd	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...		4	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	3
„ 30th	1	...	...	...	...	...	1	1	...	...	...	...	4	4	6	4		...	2	2	...	...	...	...	15	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		29	22
May 7th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	3		...	1	1	...	...	...	...	1	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	7
„ 14th	...	...	...	...	...	...	...	...	...	...	...	...	1	1	2	3		...	2	1	...	...	2	1	...	1	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8
„ 21st	...	...	...	...	...	...	...	...	...	...	...	...	1	1	2	2		...	1	...	...	...	1	...	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	5
„ 28th	...	1	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	3	3	...	...	...	1	2	2	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...		1	...	...	...	...	...	...	...	8	7
June 4th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	2	...	...	3	2	...	...	1	1	4	3	1	1	...	...	1	1	...	...	...	...	1	1	...	...	...	...	...	...	...	1	...	...	...	...	1	1	15	13
„ 11th	...	...	...	...	...	...	...	...	...	...	1	...	1	...	7	4	1	...	...	...	...	...	2	2	1	1	2	1	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	9
„ 18th	...	...	...	...	...	...	...	...	1	1	1	...	1	2	5	5	...	...	3	1	...	...	1	1	3	3	...	1	...			...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	1	1	1	...	...	...	19	15
„ 25th	...	...	...	...	...	...	...	...	1	1	3	4	1	1	6	3	3	2	2	2	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	19	14
July 2nd	...	...	1	1	...	...	...	...	1	1	...	...	2	2	8	8	1	1	2	1	...	...	1	...	...	1	2	2	1	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	21	19
„ 9th	1	1	...	...	...	...	...	...	2	2	2	1	2	...	3	2	...	...	2	2	...	...	*1	...	...		1	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	10
„ 16th	...	...	...	...	...	...	...	...	1	1	2	3	3	3	...	...	1	1	1	1	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	12	12
„ 23rd	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	1	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	...	...			...	...	...	...	...	...	4	4
„ 30th	...	...	...	...	...	...	...	...	2	2	...	...	...	...	1	...	1	1	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	4
On July 31st only	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
Total	2	2	1	1	...	...	1	1	9	9	10	9	17	14	47	36	7	5	28	21	...	...	11	7	31	28	7	7	2	1	1	1	...	...	...	...	5	4	3	2	...	...	...	...	1	1	1	1	1	...	5	5	190	155

Very little evidence could be obtained as to the manner in which the infection was carried from place to place or from person to person, partly on account of the difficulty of getting an accurate history. In the case of a European who lived in airy rooms on the roof of a lofty building, I was informed that his pet dog brought a dead rat and deposited it in his bed. The dog was said to have been sick for a day or two afterwards.

The total number of attacks of plague up to the end of July was 190, or 0·027 per cent. of the population. The number of deaths was 155 in 16 weeks, or 0·74 per mille per annum. The case mortality was 81·5 per cent. The number of male attacks was 152 and female 38, giving a proportion of 400 to 100. This large excess of male over female deaths occurred amongst the Hindus and Muhammadans. In the Hindu population there are 174 males to every 100 females, but the plague attacks were in the proportion of 483 to 100, or 2·7 times more numerous among men than among women. In the Muhammadan population there are 197 males to 100 females, but the attacks were in the proportion of 600 to 100, or 3·04 times more numerous among men than among women. The following table gives attacks and deaths according to the classes of the population. The attacks and deaths per 1,000 of the population per annum were—(1) Hindus 0·75 and 0·6, (2) Muhammadans 0·89 and 0·76, and (3) Christians (Europeans and Eurasians) 2·8 and 1·7. It is thus seen that the disease was far more prevalent among Christians than among Hindus and Muhammadans if there was no concealment of cases among the two latter classes, whilst the case mortality was much lower—being only 60·7 against 80 and 85·3.

	Hindus.		Muhammadans.		Eurasians.		Europeans.		Chinese.		Burmese.		Jews.		Total.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
Seizures .	87	18	48	8	13	11	1	0	2	0	1	0	0	1	152	38
Deaths	75	13	41	7	7	8	0	0	2	0	1	0	0	1	126	29

"In Bombay it was found that the ages most exposed to risk ranged between 20 and 40 years in both sexes. Thirty years seems the maximum danger point. From youth up to this figure the disease gradually increases, and, having reached its height, then manifests a corresponding decline as the age advances. Plague then may be characterised as more virulent in adult life than at any other period." The experience in Calcutta so far as it goes is entirely in accord with the above as shown in the following statement:—

Attacks and deaths from Plague from 14th April to 31st July 1898.

Age.	ATTACKS.			DEATHS.		
	Male.	Female.	Total.	Male.	Female.	Total.
0—1	...	...	...	...	...	...
1—4	5	1	6	3	...	3
5—9	2	6	8	2	5	7
10—19	28	11	39	17	9	26
20—39	69	12	81	61	9	70
40—59	31	5	36	27	5	32
60 upwards.	11	2	13	10	...	10
TOTAL .	146	37	183	120	28	148
Age unknown	6	1	7	6	1	7
GRAND TOTAL .	152	38	190	126	29	155

The incidence of attacks in dwellings was as follows:—

Huts	52·1 per cent.
Pucka houses, upper storey .	7·3 " "
" " lower storey .	26 " "
Stables, godowns and servants' quarters	14·6 " "
Total .	100·0

The following is the number of cases treated in public and private hospitals:—

Medical College Hospital . . .	43
General Hospital	1
Campbell Hospital	18
Mayo Hospital	13
Chandney Hospital	2
Manicktollah Plague Hospital . .	21
Ward Hospitals	9
Family Hospitals	3
TOTAL .	110

Many of the ward hospitals were not opened until nearly the end of the period under review and some of them were not ready even then, which partly accounts for the small number of patients admitted.

History repeats itself, and the history of plague epidemics shews that there are at first many persons who disbelieve in the reality of the visitation. In Calcutta the opinion was in the beginning and is still freely expressed in certain quarters that the disease is not true plague but a form of fever with glandular swellings which is well known to practitioners in the town as being endemic in Bengal. Another ground for disbelief in the plague is that, though it has been present in the town for several months, it has not manifested the epidemicity characteristic of the disease. A great deal has been made of the fact that it has not as a rule spread through a house, and the erroneous conclusion has been drawn that it is not infectious. The high mortality, however, the clinical symptoms, the pathological appearances and the bacteriological cultures stamp the disease undoubtedly as true plague. The slow development is by no means unusual. In the Great Plague of London of 1664, according to Defoe, the first cases were recognised at the end of November when two men, said to be Frenchmen, died in Drury Lane or Long Acre, but the disease did not become really epidemic until the following June, the winter being long and severe. Of the great plague of Moscow of 1770* we learn:—"One of the most striking facts in the history of the epidemic is the slowness with which the infection seemed to gain a hold in Moscow. It was, there is little doubt, introduced by the Turkish prisoners taken in one of Catherine's numberless campaigns against the Turks. But, though the first deaths from plague occurred among the prisoners in Moscow in October, 1770, it was not until the following summer that the disease became at all widely epidemic." In Hong-kong, in 1894, isolated cases occurred from January to March, and the disease did not increase much until May. In Bombay City the first cases appear to have occurred in July, or even earlier, though the disease was not officially declared until September, but they did not increase sufficiently to occasion any great alarm until the latter part of November. In the Satara district of the Deccan only 88 indigenous cases were reported in the first four months, but the disease subsequently developed extreme epidemicity. Other instances might be adduced to show the subtlety of the invasion and slow progress of the disease at the onset, especially when the climate is either very cold or very hot. So the slow progress which the disease has made in Calcutta is no ground for saying that it is not true plague. I have frequently been asked whether the disease will spread in the cold weather. I can only reply that as there is no previous history of plague in Calcutta there are no data on which to give an opinion what influence seasonal conditions may have in this particular town, but judging from the history of the disease in other places there is the strongest possible reason for not relaxing precautions, or making reductions in staff and establishment, until we are quite certain that there is no more plague in the town.

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* Notes on some "Past Epidemics of Plague in Russia." By Dr. F. G. Clemow, M.B., D.P.H.

The greatest difficulty in dealing with the plague has been the distrust and suspicion with which all plague officers are treated. I am assured by a native medical practitioner who knows the people thoroughly that a large proportion of them believe that the Viceroy met a *Yogi* in some remote spot in the Himalayas, and made a compact with him to sacrifice two lakhs of lives to the Goddess *Kali*, from whom the city of Calcutta takes its name to save the British Government in India, which she would otherwise overthrow. Such being the case, it is hardly to be wondered at that they fear the plague doctors, who are popularly supposed to give a black pill or a white powder which causes instant death, but who, as a matter of fact, have throughout shown the greatest tact and consideration for their caste and family customs, and given no cause whatever for fear or unpopularity.

On the 23rd July, under orders from the Government of Bengal, I handed over the medical charge of plague operations in Calcutta to Surgeon-Major W. B. Bannerman, M.D., B. Sc., in order to give special attention to the conservancy of the city. No cases were reported during the last three days of my tenure of office.

INOCULATION.

A stock of Haffkine's prophylactic and some Roux syringes were obtained with the sanction of the General Committee of the Corporation from the Bombay Research Laboratory in January. The inoculation campaign was opened on Saturday, the 30th April, the date of the official announcement of plague, when at the request of Surgeon-Lieutenant-Colonel G. S. A. Ranking, Senior Medical Officer of the General Hospital, where a fatal case of plague had occurred, ten inoculations were done amongst the staff and menial establishment. The following day, Sunday, Dr. Ranking was inoculated at his house with some friends and one or two of the servants, most of whom refused at the last moment through fear on account of the wild stories of the effect of inoculation that were already flying about. The same day at the request of Babu Dwarka Nath Ganguli, Assistant Secretary to the Indian Association, and his wife, Dr. Ganguli, I proceeded to 13, Cornwallis Street, and inoculated 61 members of the *Brahmo Samaj*, men, women and children. This was the first contingent of the native community that volunteered for inoculation, and the experiment, if such it can be called, was watched with keen interest by members of the other communities. Reports reached me of several of the inoculated persons having died, which turned out to be groundless, as none of them had more than the transient fever and local reaction which the prophylactic is expected to produce. Whether the stories were started by malicious persons or not I am unable to say, as I was unable to trace them to their source, but I do not think I operated anywhere for two or three weeks without some one telling me that at least one of my patients had died, though no such catastrophe happened. This culminated in one of the leading papers publishing a circumstantial account of the death of a Eurasian, named Walters, living in a certain street, which, it was alleged, was unquestionably due to inoculation, and this was copied by a number of other papers, though no such person had been inoculated and no such person lived in the street. As this statement was clearly defamatory and at the same time likely to deter people from being inoculated, I instructed my solicitors to take action, and they ultimately obtained an admission that there was no truth in the statement, and an apology from the editor which was published in the principal papers.

On the 2nd and 4th May, at the request of Mr. J. G. Apcar, I inoculated the students of the Armenian College, nearly 100 in all. On the 3rd two vaccinators, who went to conduct animal vaccination in a bustee near the Medical College, were mistaken for inoculators, mobbed and beaten; and such was the hostility shown whenever vaccinators appeared that it was found necessary to stop vaccination for the time being. On the same date, at the request of Surgeon-Captain F. P. Maynard, I went to the Presidency Jail, and inoculated 30 of the staff and prisoners. On a later date I inoculated Mr. Larymore, the Superintendent, and some of the warders and prisoners at the Alipur Jail. Mr. Larymore missed his servants shortly before the inoculation and on going to look for them found them collected together in a godown, where an old hag was haranguing them. "Every man, woman and child who has been inoculated," she was saying, "has fallen down dead on the spot, and I tell you that every man, woman and child that will be inoculated will likewise die." This is a fair specimen of the kind of old wife's tale that the people were ready to believe. The same day, 4th May, the following letter was received from the Bengal Chamber of Commerce, the inoculation-scare being at its height:—

"I am directed by the Committee of the Bengal Chamber of Commerce to represent to you the urgent necessity of notice being immediately given, in the most widespread manner possible, whether by hand-bills or by beat of drum, that there is no intention on the part of the authorities to make inoculation compulsory. It is especially necessary that the notice should be conveyed in such a manner as to be plain to the most ignorant people, as there is still a widespread idea, erroneous of course, that Government are intending to introduce compulsory inoculation. A strike of considerable magnitude took place yesterday among the coolies employed by the different importing houses to remove goods to the bazar, and considerable obstruction resulted to business in consequence. The Committee are informed that both railway and ship coolies are also abandoning their work in large numbers, and they have no doubt you will realise the great importance of prompt action being taken in the matter."

The reply stated that the following notice was being issued from the Municipal Office:—

"(1) Any one desiring to be inoculated may apply to the Health Officer.

(2) No one will be inoculated against his will.

(3) Any unauthorised person found inoculating will be punished."

At about the same time the so-called "Risley-ticket" was issued in English and the vernacular, and largely circulated by business firms amongst their employés, and masters amongst their servants. It ran as follows:—

"This is to certify that no one shall be inoculated unless he expressly desires it. Copy of this given to .

H. H. RISLEY,

Secy. to Govt. and Prest., Plague Commission."

Two Eurasian boys are credited with having been instrumental in causing the inoculation scare by a practical joke. It is said that they seized a native *halwai* (sweet-meat vendor), and marked a cross in red ink on the back of his neck, telling him that the surface where they made the mark would swell, a blister would form, and when the blister broke he would die of plague. The man fled to his people, showed the mark and excited them by a graphic description of the outrage he had suffered at the hands of the *ticca-wallahs*. Whether this story is true or not, it is certain that the panic and disturbances, in one of which, as has already been stated, an Austrian, who was carrying a small hand-bag, was brutally murdered on the supposition that he was an inoculator, were fomented by the criminal classes for their own ends. Several men were arrested for personating doctors of the Health Department and going into houses, levying black-mail on pain of inoculation, and were sentenced to varying terms of imprisonment. A young man in the Licensed Measurers Department was returning home on his bicycle wearing a cap with the letters L. M. D., when he was surrounded by a mob shouting "Here is an inoculator. Let us beat him!" He showed considerable resource, however, and whipping off his pump pulled it out to its full extent and threatened to blow up the first man who attempted to stop him. The ruse succeeded, and the young man rode off without loss of time. A report spread amongst the *gharri-wallahs* that they and their horses were to be inoculated, and many of them drove out of the city, thus causing great inconvenience for the time being. They soon returned, as a jarvey with a hackney-carriage cannot pick up fares in the jungle. It is extraordinary how natives occupying a respectable position gave credence to the wildest and most improbable stories. The following letter, which appeared in one of the daily papers, is an instance of this:—

"On Tuesday, between 9 and 10 A.M., a durwan in the employ of Mr. Justice Romesh Chunder Mitter, while bringing home some bags of gram, was beckoned to by *parawallas* (constables) who were standing near two hackney-carriages. He went to them, and one of his hands was held by a *parawalla* while two men descended from one of the carriages. One of them encircled him from behind with his arms, and the other inoculated him on the left wrist. The durwan struggled to free himself and made a row, attracting a number of passers-by. On this the perpetrators of this forcible inoculation got into the *gharri* and drove away with great speed. This took place at Bhowanipur near the Tram depôt."

If a man was questioned as to what he was afraid of, he replied that the *ticca-wallah* would inject poison, and he would die of the plague: the *hukum* (order) had gone out. When asked how it was that *sahibs* were inoculated and got well, he replied that the *topee-wallas* were *ticcaed* with different stuff. To show that this was untrue and to inspire confidence on several occasions, I inoculated a European with half a 10 c.c. syringe of prophylactic and a native servant with the other half.

It is somewhat remarkable that in spite of all the panic and popular indignation against *ticca-wallahs*, and though there was not enough plague in the town to frighten people into being inoculated, inoculation progressed steadily. On Wednesdays and Saturdays people came to my office to be inoculated, and we went almost daily to private houses to do families. Also, though many persons suffered molestation on the supposition that they were *ticca-wallahs*, the only real inoculators, Dr. Margaret Traill Christie and I, and our assistants, Drs. Dutt and Ghose, went about the town inoculating without a guard and were never assaulted. On occasions children ran after my carriage, calling out "*ticca-wallah, ticca-wallah*," and crowds collected in the streets where we were operating. Our coachmen apparently did not wish to linger on those occasions, for they drove off at the speed of a London fire brigade without any orders from us.

One of the first, if not first, native gentleman of position, to set an example was Raja Benoy Krishna Bahadur of Shova Bazar, who was inoculated at the *Rajbari* with the Maharani and other members of his family and friends, to the number of 60 in all, on the 10th of May. He did not ask his servants to be done on account of the panic amongst their class, but after the family had been inoculated, the servants came in a body and asked why they were not to be permitted to share the benefit of the *ticca*. The Raja was subsequently instrumental in bringing many more people for inoculation, including a Brahmin Pundit of high position and his wife, and also the residents of bustee lands which he owned, some of whom were scavengers. One of the first persons who applied for inoculation was the *Mahunt* of a big temple who asked me to do him and his temple staff, and to disinfect the temple premises once a week. Apparently he took fright at the alarming reports that were circulated, for I saw no more of him. If left alone, he will probably apply again when plague begins to spread in his immediate neighbourhood. Some of the Police Inspectors, European and native, and a few of the River Police were inoculated.

The first Muhammadan gentlemen to take up inoculation were, the Hon'ble Moulvi Mahomed Yusuf Khan Bahadur and Munshi Abdul Ali, who were inoculated before a large gathering of their community, and explained the objects of inoculation to them. Dr. Christie inoculated the ladies of their families. The result of this enlightened action was that we were repeatedly invited to the neighbourhood, where we were most cordially received, and inoculated nearly the whole of the Muhammadan population there, both rich and poor. Muhammadans in other quarters also came forward more than any other community. It appears that the ladies of their families advocated our cause through fear of violation of their sanctuary and removal to a segregation camp. They said the *ticca* was nothing. The cause was not without advocates amongst European ladies, for a Mr. X. wrote asking me to inoculate him on the earliest possible occasion, and enclosed a telegram from his wife despatched from Bombay, which ran—"Get yourself inoculated at once."

As the Marwari exodus was seriously affecting the trade of the town, and was due more to fear of segregation than of plague, I was anxious to get the community inoculated as far as possible. Messrs. Anderson, Wright and Company succeeded in persuading their broker, Babu Bhujan Lal Lohea, to be inoculated with his family, and he used his influence with other members of the community. The first two were inoculated in the Health Office on 8th June. On the 11th I inoculated a few more in a hall in Harrison Road in the presence of a large concourse of curious spectators. Harrison Road was so crowded with people interested in what was going on that we had difficulty in driving away. A few more were subsequently inoculated, and their fear of the operation was largely overcome, though stories were spread about that they would get ill and die a year after inoculation, but they said there was no plague, so why should they be inoculated. They will probably seek this means of protection when the disease assumes a more epidemic character.

The following statement shows the progress of inoculation by week and by caste:—

	Hindus.		Muhammadans.		Europeans.		Other Nations.		Total.		GRAND TOTAL.
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
30th April, 1898.	3	...	...	...	1	6	...	...	4	6	10
1st to 7th May, 1898	82	54	18	...	19	3	84	5	203	62	265
8th to 14th May, 1898	59	40	6	...	15	2	3	...	83	42	125
15th to 21st May, 1898	86	56	146	104	3	2	16	8	251	170	421
22nd to 28th May, 1898	16	5	11	2	1	...	1	...	29	7	36
29th May to 4th June, 1898	15	5	9	2	4	...	3	1	31	8	39
9th to 11th June, 1898	46	9	188	138	3	4	2	1	239	152	391
12th to 18th June, 1898	58	4	149	32	17	1	15	5	239	42	28
19th to 25th June, 1898	141	57	145	89	7	3	7	13	300	162	462
26th June to 2nd July, 1898	31	15	44	22	2	...	2	3	79	40	119
3rd to 9th July, 1898	33	22	39	26	3	28	9	13	84	89	173
10th to 16th July, 1898	13	13	28	19	1	27	...	14	42	73	115
17th to 23rd July, 1898	23	3	15	1	8	...	1	2	47	6	53
TOTAL	606	283	798	435	84	76	143	65	1,631	859	2,490

The break about the end of May was due to the *Mohurrum*. The decline towards the end of the period that I had charge of the work is attributed to the fact that the people were beginning to disbelieve in the reality of the plague, as the native papers were constantly putting forward the view of the majority of the native practitioners that the disease was not plague but a form of bubonic fever endemic in Bengal. It took very little to deter people from being inoculated. For instance, when I visited a bustee where I was to inoculate over 100 persons, only about 15 came forward, as a man in the bustee who had been inoculated with plague prophylactic a month before had been taken to hospital suffering from choleraic diarrhœa. Again, a Muhammadan of position had boils after inoculation. Though it was the season when boils are most prevalent and he would probably have had them in any case, this was attributed to inoculation and adduced as a reason for abstaining from it. The largest number of inoculations done in a single day was 255 on the 21st May. The number of Hindus inoculated is small compared with the Muhammadans, as there are about two Hindus to one Muhammadan in the town, but I was informed that they would come with a rush as soon as the signal that it was time to do so was given by their leaders. So that I think there is a fair prospect of what I hoped, but could hardly expect, at the commencement, that before the plague spreads very far, at least half the population of Calcutta will be protected. The number done up to now is of course but a small percentage of the population, and could not appreciably affect an epidemic, but it is enough to disabuse people's minds to a considerable extent of the fears implanted in them by silly or malicious persons. Fortunately, no inoculated person has died of plague, nor has any one died of any other disease shortly after being inoculated, to give a handle to the opponents of inoculation. A good reaction was almost invariably obtained, and no abscess at the seat of inoculation or other untoward result of any kind has occurred. A ticket is presented to each inoculated person with the coat of arms of the Corporation emblazoned in red at the top and the thumb-mark of the recipient at the bottom to prevent traffic in these certificates. The following extract from the *Englishman* of the 15th July is interesting as showing the change in public feeling about inoculation from what it was at the commencement of operations :—

"Dr. Cook and Dr. (Miss) Christie, accompanied by Drs. Dutt, Ghose and Mitter, went on Wednesday to Ghoogoodanga Road in Ballygunge, to inoculate some Muhammadans. The inoculations were to take place in the new ward hospital, which was liberally decorated with bunting and triumphal arches, and a string band was in attendance to enliven the intervals. Drs. Cook and Christie met with a grand reception, and before they went away, they were decorated with garlands by the hands of Moulvie Mozarha Hossein, the leading Muhammadan. In all thirteen Muhammadans were inoculated, ten males and three females."

Drs. Dutt and Ghose having previously carried on cholera inoculation, proved most useful assistants, as they could be trusted to open bottles and fill syringes with thorough aseptic precautions, which I consider the most responsible part of the work, and I cannot too highly praise the courage and never-failing cheerfulness of my colleague, Dr. Traill Christie, in going out day after day on what she knew to be a somewhat perilous mission, for she remarked when the town was getting over its excitement—"It is quite a pleasant change to go out without the expectation of being killed."

J. NIELD COOK, D. P.H.,
Health Officer, Calcutta.

The 31st August 1898.

(*Reprinted from the* Indian Medical Gazette, *Vol. No. XXXIII, dated the 9th September 1898.*)

THE PRESENCE OF BUBONIC PLAGUE IN CALCUTTA :*

BY W. B. BANNERMAN, M.D., B.SC.,
Surgeon-Major, I.M.S., *Special Health Officer, and*
DR. J. NIELD COOK, D.P.H.,
Health Officer of Calcutta.

As it has been persistently maintained, in certain quarters in Calcutta, that no plague exists in the city, the history of the following cases, in which the diagnosis has been established by cultivation of the specific organism of the disease, may prove of interest at this time.

No one has, we believe, ventured to deny that the bacillus of true plague is the only one known which produces Haffkine's "stalactite growth" in broth. It follows then that, if this growth is seen, we are dealing with the microbe of plague and none other. As will be seen later on, this characteristic appearance was found by us, and verified by numerous independent observers, in three out of the four cases examined ; we are compelled, therefore, to state that these were undoubtedly cases of true bubonic plague.

On the 2nd August a report was received from Captain Rainey, Executive Officer of District No. 2, that "In Ward 7, Roop Chand Roy's Street, No. 14, five people have died within a fortnight." Dr. Mackenzie, the District Medical Officer, reporting on this on the 4th August, says :—"I find that the people in the *bustee* admit there have been eight deaths within about a week ; the neighbours, however, state that there have been about twelve deaths. From the information I could get as to symptoms I should think there is no doubt many, if not all, the cases, were due to 'plague.' One woman was beginning to state that one of the persons who died had glandular swelling, when she was stopped. The last death took place yesterday." On the 5th August an anonymous vernacular post-card, dated 30th July 1898, was received reporting thirteen deaths from plague in Sew Dyal's house, 14, Roop Chand Roy's Street. On the 6th August, a thorough inspection of the place was made by the Chairman of the Municipality, the Engineers and ourselves. The premises were found in a most insanitary condition, but no cases of illness were discovered. At a meeting convened by the Chairman on the 7th August, at which many of the members of the Vigilance Committee of the ward were present, it was resolved, in accordance with the wishes of these gentlemen, that the houses should be vacated. The hospital buildings at Marcus Square were accordingly made available as temporary quarters for the inhabitants, some 200 in number. None of them, however, availed themselves of this offer, but preferred to seek lodgings for themselves elsewhere.

The following events have since occurred, and are interesting as illustrating the mode in which the contagion is disseminated, and forms fresh foci of disease :—

(*a*) On the 10th of August a case was reported at Burtollah Street ; on enquiry it was found that the man had come from Roop Chand Roy's Street the day before, had fever during the night, and left for Howrah in a *ticca gharri* in the morning. The Police were communicated with, but no trace of him has been found.

(*b*) On the 11th of August four cases were reported by the Police from 5, Municipal Office Street. These were traced to Roop Chand Roy's Street, either directly or through relatives, as the tree below will show ;—

Matai Halwai (M) =	Bhagvati (F)	Ram Sarup (M).
No occupation ; lived sometimes with sons, sometimes with wife. Arrived from Doyahatta on 6th August, 1898. Found dead, 11th August, 1898.	Wife of Matia Halwai, lived at 5, Municipal Office Street, but often went to Roop Chand Roy's Street, and spent days there. Had been in Doyahatta since leaving Roop Chand Roy's Street. Arrived 10th August, 1898. Found dead, 11th August, 1898.	Found ill and removed to hospital. 11th August 1898. Died same day. Had been in Doyahatta after leaving Roop Chand Roy's Street. Arrived 9th August, 1898.

Deoki (M)	Ram Charan (M) = Daughter	Jaiseri.
Had sweetmeat shop at 5, Cross Street, but lived at Roop Chand Roy's Street. Brought by mother to 5, Municipal Office Street, and died there 28th July 1898. Death not reported.	Lived, with wife, father-in-law Ram Sarup and brother-in-law Jaiseri, in same house as Deoki, but in separate room. Died at 5, Cross Street, on 6th August, 1898.	Boy aged 4. Found ill 11th August, 1898, and removed to hospital, where he died 12th August, 1898.

When the *bustee* was vacated, Matai Halwai, Bhagavati, Ram Sarup, Jaiseri and Ram Charan's wife went to Tika Ram's house, Phul Bagan, Doyahatta, off Burtollah Street, and all except the latter fled to 5, Municipal Office Street, from there. Ram Charan's wife and a newly-born child are the only survivors of this ill-fated family.

(*c*) An old woman from the same house in Roop Chand Roy's Street died of fever on the 12th of August, at 20,

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* This note has been added as an Appendix to the foregoing report, as it clearly shows how plague may spread through a family, which, as has previously been stated, has been repeatedly denied in Calcutta. The writers were not responsible for the action taken in evacuating premises without segregation or inoculating inmates.—J. N. C.

Armenian Street. She is said to have suffered from fever every month for the last two years, as she had elephantiasis of the leg.

(*d*) Twenty-five persons from 14, Roop Chand Roy's Street, removed to 6, Babu Lal's Lane, off Harrison Road, a most insanitary *bustee*. The District Medical Officer reports on 15th August :—" Two men were reported as suffering from fever in this *bustee* ; I went to investigate the matter, but could not find them, and could not search the place owing to there being a lot of women there."

(*e*) At 5, Cross Street, Ram Charan died, as above reported. From this it seems probable that new foci of infection have arisen in the following places, namely, Municipal Office Street, Cross Street, Burtollah Street, Howrah, Doyahatta, Armenian Street and Babu Lal's Lane.

History has a tendency to repeat itself, as shown by the following extract from Defoe's " Journal of the Great Plague Year " :—" In this interval between their being taken sick and the examiners coming, the master of the house had leisure and liberty to remove himself, or all his family if he knew whither to go, and many did so ; but the great disaster was that many did thus after they were really infected themselves, and so carried the disease into the houses of those who were so hospitable as to receive them, which, it must be confessed, was very cruel and ungrateful."

On the 11th of August we visited 5, Municipal Office Street, and found the woman Bhagavati and her husband Matai Halwai lying dead ; the former on a *charpoy* in the outer room, the latter on the ground in the inner : the former had a boggy right axillary bubo : the latter had no outward signs to show what he died of. We went on to the Ward Hospital and found Ram Sarup and the boy Jaiseri, whom we examined in consultation with Dr. Comley, who was treating the cases. When first we went in, Jaiseri was lying on his left side, with the right thigh drawn up, as if to relieve tension in the groin, where there was some tenderness on palpation, though no bubo. He was very restless, but once half protruded his tongue after being several times told to do so. The dorsum presented the characteristic parchment appearance, and the tip and edges were clean. His eyes were slightly congested ; temperature was 104°. He died the following morning. Ram Sarup was lying on his back breathing rapidly and was evidently *in articulo mortis*, and died ten minutes later. There was nothing to indicate the nature of his illness.

Cultures were made *post-mortem* by Dr. F. Clemow and ourselves from Bhagavati, Matai Halwai and Ram Sarup, and by Dr. Clemow from Jaiseri. In Bhagavati's case they were made from the bubo, in the others from the blood in the liver, by inserting, after cauterising the skin, a capillary pipette and spreading the contents over agar-slopes. In all except Bhagavati's case, growths characteristic of plague were obtained, though somewhat later than usual, owing, it is believed, to the nutrient medium being somewhat dry and hard. On the 17th, the cultures having in the meantime been transferred to fresh agar, flasks of peptone bouillon, with *ghee* floating on the surface, were inseminated from the slopes. Two days later, the 19th August, when a light was placed behind the flasks in the dark incubator, abundant silky stalactites were seen depending from the surface through the medium, by ourselves and several independent medical acquaintances. This, as we have already said, is held by bacteriologists to be final and conclusive proof of plague, as no other bacillus has been found to grow in this peculiar way. The question of making *post-mortem* examinations in these cases was considered, but though no one would have been more interested than ourselves in seeing whether any internal glands were affected, and whether internal hæmorrhages had occurred, we advised against it on account of the danger to the Domes making such examinations. It is somewhat curious that the one case in which we failed to separate the bacillus was the only bubonic case. This may have been due to our missing the gland in the large boggy bubo, and only drawing material from the axillary fat, or it may have been due to the case being similar to the one mentioned at page 71 of General Gatacre's report, in which, though plague bacilli were found by the German Commission on three occasions during life, yet none could be detected by them at the *post-mortem* examination. There can be very little, if any, doubt, however, that she died of true plague, considering that she came from Roop Chand Roy's Street, and died of an acute fever with axillary bubo.

Chart showing Percentages of Births and Deaths above and below the weekly means for 5 years.

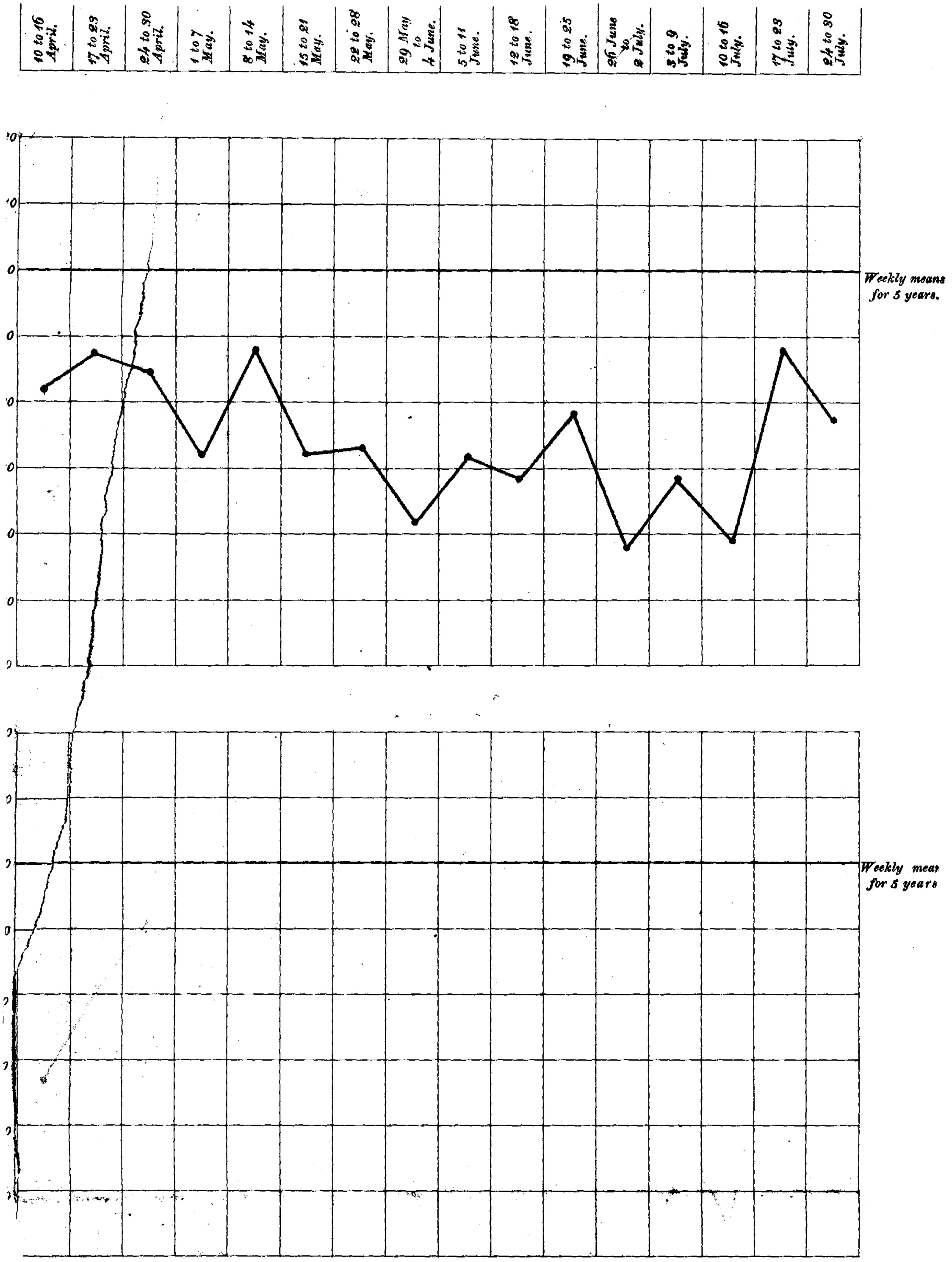
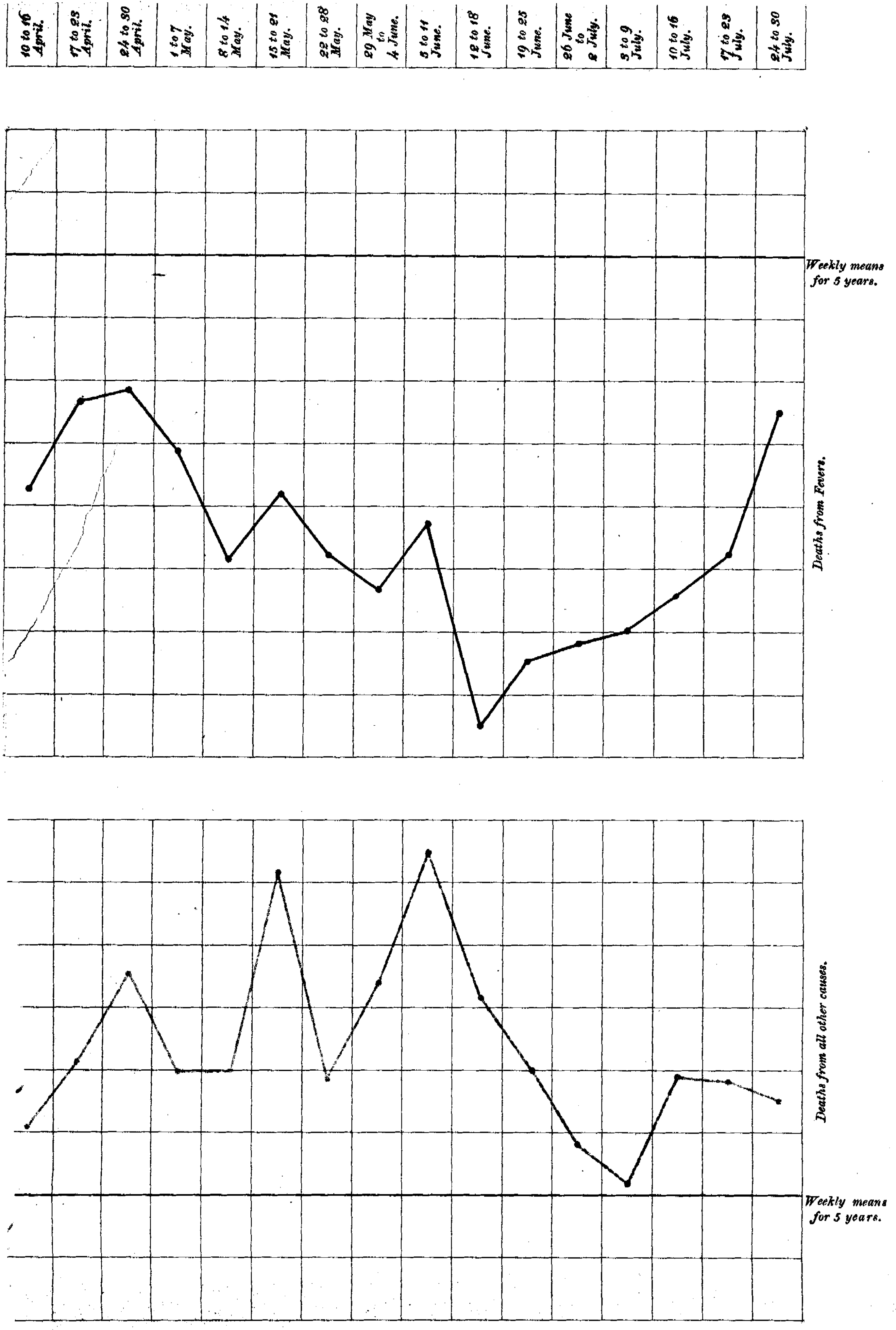
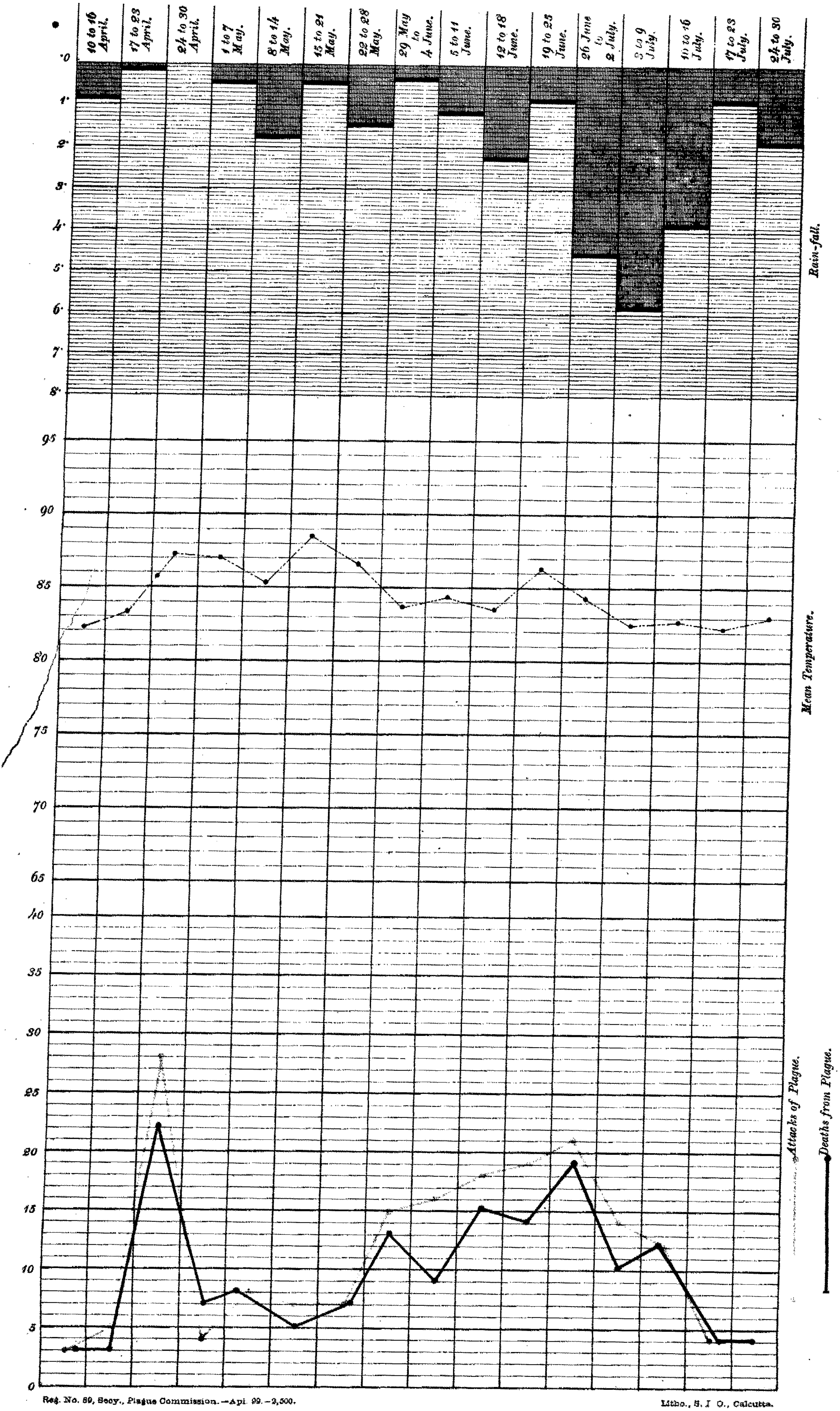


Chart showing Percentages of deaths from fever and all other causes above and below the weekly means for 5 years.



Appendix XX.



Reg. No. 89, Secy., Plague Commission.—Apl. 99.—2,500.

Litho., S. I. O., Calcutta.

Appendix XX.

APPENDIX No. XXI.

NOTE OF THE SPECIAL MEDICAL BOARD, CALCUTTA, ON THE CASES REPORTED AS PLAGUE IN CALCUTTA, 1896, WITH REPORTS ON SUSPECTED CASES.

The following eleven cases have been reported to the Medical Board as cases of bubonic plague in Calcutta, besides certain cases in the Fort, which, on enquiry, proved to be ordinary non-venereal buboes:—

* One case in Howrah.
* One case in Chatawallah Lane.
* Two cases in Manicktolla Hospital.
Two cases in the Presidency General Hospital.
* One case in Raja Raj Bullub Street.
* One case in Armenian Street.
One case in Wooltadanga.
One case in Garden Reach.
One case in Warris Bengan Lane.

In the cases marked with an asterisk, the plague bacillus is said to have been found in the blood of the persons attacked. Three others were found to be cases of simple enlarged glands, fever and bronchitis and intestinal obstruction respectively. The result of the examination of the blood of the two cases in the Presidency General Hospital is not known to us. As a full history of all these eleven cases is contained in the appendix to this report, it is not necessary to recapitulate them here, and a summary of the conclusions drawn from these will therefore be sufficient in this place.

The bacillus is also said to have been identified in the case in Raja Raj Bullub Street, which terminated fatally. This case was first reported by a homœopathic practitioner to the Health Officer of Calcutta by post-card on the evening of the 2nd November. It was seen by Drs. Cobb and Simpson on the 3rd at 5-30 P.M., and the man died in their presence at 6-30 the same evening. They reported it "as a fatal case of true plague." The Board of Health did not hear of this case till the following day, after the body had been disposed of, and then only from private information. An interval of nearly 20 hours occurred between the time the case was first seen by the homœopathic practitioner and the time it was inspected by Drs. Cobb and Simpson. It is to be regretted that Drs. Cobb and Simpson did not call in one of the medical members of the Board, who would have been only too willing to go and see "a true case of plague." The omission is the more unfortunate, because doubt had arisen in the public mind regarding the diagnosis of the previous cases. Drs. Dyson and Robson-Scott, however, as soon as they heard of the case, proceeded to the spot and made minute enquiries concerning it, with the result that it was clear that other reasons existed for the enlargement of the glands in the groin, which was reported to be one of the prominent features of the case.

The most noticeable point in the suspicious cases that have occurred is the fact that all the patients in whose blood the plague germ is said to have been found recovered, with the single exception of the case in Raja Raj Bullub Street, and in this case, as already stated, the symptoms noticed can reasonably be ascribed to other causes. Another remarkable fact is that none of these six sporadic suspicious cases produced any infection, either in the neighbourhood or even amongst the people who attended the sick.

Looking only to the clinical symptoms set forth in the appendix to this report, we have no hesitation in expressing our emphatic opinion that none of these cases, including the fatal case of Bipin Behari Dutt, can properly be described as cases of bubonic plague. It may be inferred, however, from the reports which have come before us, that the diagnosis made by the Health Officer and Dr. Cobb is based not so much upon the symptoms of the patients as upon the supposed presence in their blood of a microscopic organism stated to be "the plague bacillus." We propose, therefore, to examine the evidence bearing on this point, and to state how far the conclusions arrived at by Drs. Cobb and Simpson are borne out by the independent investigations carried on by our colleague, Dr. Cunningham.

Dr. Cunningham has received from M. Haffkine a type-culture and several microscopic preparations of the plague bacillus as occurring in Bombay. These agree in their characters with those described as characteristic of the plague bacillus as found in China, and there can be no reasonable doubt that the Bombay bacillus is the same as that which is regarded by M. Yersin and Professor Kitasato as the specific cause of plague.

Dr. Cunningham has also personally obtained 20 microscopic preparations and 15 cultures of blood from seven distinct cases of supposed plague, six of which occurred among men in the Shropshire Regiment. The microscopic preparations show nothing, except that some of the subjects suffered from anæmia; while the cultures have without exception remained absolutely sterile.

A series of cultures and preparations of local origin was received by Dr. Cunningham from Drs. Simpson and Cobb. None of these exhibit the characters of the standard type. In one instance only does the growth in the form of colonies present some similarity to that of the type specimen; but in this case the microscopic characters do not resemble those of the Bombay bacillus. In another case the culture yielded an absolutely pure growth of a large *staphylococcus*, which is of common occurrence in the air; while the corresponding blood preparation showed evidence of contamination from other sources in the presence of a certain number of slender bacilli. In a third culture there was a pure growth of a form of *schizomycete* or fungus, of which neither the colonies nor their constituent elements bore the remotest resemblance to the plague bacillus. A fourth culture prepared from the blood of Bipin Behari Dutt contained large bacilli, probably of a putrefactive character, along with minute *cocci* and *diplococci*; but in the microscopic preparation of the blood only the large bacilli could be recognised. The remaining cultivations of local origin are pure cultivations of *cocci* and *diplococci*, not agreeing in character with the type specimen, and not distinguishable from forms which are liable to occur in and on almost any organic medium as the result of contamination. As the phenomena of three out of the four cases expressly referred to above furnish conclusive evidence that actual contamination occurred, there is no certain proof that in the remaining cases the minute organisms discovered were really derived from the blood.

In the case of Bipin Behari Dutt, whose clinical symptoms we have already discussed, a specimen of blood and some blood-cultures were sent to Dr. Cunningham, together with portions of a rat into which 2 cubic centimetres of a culture of blood had been injected, causing its death after thirty-one hours. The specimen of blood and the cultures showed, as has been mentioned above, unequivocal evidence of contamination by the presence of large bacilli, probably of a putrefactive character, which must have gained access to the preparation from outside.

This being so, it is clear that the smaller *cocci* and *diplococci*, which were also found, may equally have been the result of contamination. Nor does the death of the rat after inoculation afford any grounds for inferring the specific character of the germs contained in the culture, with which the animal was inoculated, for the bulk of actively decomposing fluid injected into the animal was relatively equivalent to over a pint in the case of an adult human being, and was quite sufficient to cause death by mere blood poisoning. Moreover, had the enormous number of microscopic organisms introduced into the rat possessed the specific character attributed to them, the blood and tissues ought after death to have absolutely swarmed with the organisms, whereas in fact only a very scanty sprinkling of minute *cocci* and *diplococci* could be found in the specimens submitted to Dr. Cunningham.

Looking to the evidence as a whole, we have no hesitation in expressing our opinion that there is no evidence that any case of true bubonic plague has yet occurred in Calcutta; and that the cases which have been reported to us as of plague were so described on the strength of an opinion as to the origin and character of certain microscopic organisms, which has not been confirmed by the results of an independent inquiry conducted by an expert of long experience in bacteriological research.

REPORTS ON SUSPECTED CASES OF PLAGUE IN CALCUTTA.

CASE No. I.—REPORTED CASE OF PLAGUE AT HOWRAH.

A telegram was received by Mr. Risley on the 9th October, stating that a case of Pestis Ambulans had occurred in Howrah.

Telegram, dated 10th October 1896.

From—Darjeeling,	To—Calcutta.
From—Civil Hospitals, Bengal.	To—DR. SANDERS.

Please keep me regularly informed by wire regarding plague, and instruct all medical officers at Presidency to keep you informed.

Drs. Ross and Dyson left Darjeeling on Sunday, the 11th October, for Calcutta.

J. Cotta, a Eurasian, aged $16 \frac{}{12}$ years, is a resident of Bombay living at Byculla, at a distance of nearly 3 miles from Mandvi. On the 13th September he exposed himself to venereal infection; on the 17th he noticed local sores, and on the 19th that the glands of both groins were a little enlarged and slightly tender. He left Bombay on the 23rd in company with his sister and her children, arriving in Howrah on the 26th. He lived in a small house in Punchanuntollah in company with his sister and children.

On the 2nd October he went to the Howrah General Hospital under the assumed name of Maddox, and was treated by Mr. Mitchell, the apothecary, who diagnosed soft sores and prescribed "black wash." At that time he had tender glands and slight fever. He returned on the 4th. The sores were better, but not quite healed; the buboes were painted with iodine; he said his fever had gone. On the 7th he again went to hospital, and was advised to become an in-patient for the further treatment of the buboes. He was directed to become a paying in-patient. He then went to the Medical College. About this time suspicion seems to have been roused about him.

S. B. Ghosal, Native Doctor to the East Indian Railway, who is at the Howrah General Hospital, states that on the 8th he was ordered by Dr. Tomes to go to Punchanuntollah to see Cotta at his house, and found him suffering from fever, with a temperature of 102°F., and swollen inguinal glands. He was visited the same evening by Drs. Tomes and Simpson; the latter aspirated blood from the finger and from the buboes for bacteriological examination. On the following day Drs. Cobb, Tomes and Simpson signed a certificate, stating that plague bacilli had been found in the blood of Cotta.

On the 11th, at the request of Dr. Ross, Inspector-General, Civil Hospitals, Cotta was examined by Dr. Sanders, who sent a telegram to Dr. Ross as follows:—

"Have seen Cotta; a typical case of syphilitic buboes; no fever. No cause for alarm."

On the 11th he was removed into the building provided by the Municipality for plague cases, his sister and a small boy accompanying him.

On the 12th he was examined by Drs. Ross and Dyson, who had just arrived from Darjeeling. Dr. Sanders also went with them.

They found him in the infectious hospital. It is situated on the road to Andul, and is a small cutcha-pucka house of two rooms with a square walled court-yard.

Both he and his sister were complaining bitterly of having been removed there. The place was full of flies, and the amount of ventilation scanty. On examination he was found to be in full possession of his senses—no headache, tongue clean, appetite good. He had inflamed glands in both groins, and stated that he had been put to considerable pain by being conveyed to the building in a gharry. His temperature was 102° F. This can easily be accounted for by the commencing suppuration in the buboes; the soft sores had completely healed. He had not received any clothes or food from Bombay since his arrival in Howrah. A consultation was held at once, and Dr. Sanders expressed his willingness to take the case into the Mayo Hospital for further treatment of the buboes. It was decided, however, to take him back at once to the infectious ward of the General Hospital at Howrah. This place was selected to avoid causing panic among the patients in the main body of the hospital.

He was visited again on the morning of the 13th by Drs. Ross, Sanders, Dyson, Vaughan, Tomes, and Mr. Maguire. He was very cheerful, tongue clean, eyes clear, no headache, pain less in the buboes. He expressed great satisfaction at the change of residence, and said he was all right. There were in the same room with him, his sister, a boy, and a female friend. The bubo on the left side showed slight deep fluctuation. It has been decided that when this is opened, some of the pus will be sent to Dr. Simpson for examination.

Dr. Ross deputed Dr. Leahy (who has had personal experience of plague in Bagdad) the same day to visit Cotta and report on his condition. He visited him at once and wrote as follows:—

"In accordance with your orders, I visited and made a careful examination of the man Cotta this afternoon at the Howrah Hospital. His condition bears no resemblance clinically to the cases of plague I saw in Bagdad. Of the two inguinal buboes, the left one is apparently undergoing suppurative changes, and to this I attributed his temperature 101° this afternoon. I have suggested the desirability of inoculating a spot on the abdominal wall with some of the pus from the bubo, when he opens it, with a view to finding out whether it will produce a soft chancre at the point of inoculation. We carefully examined Cotta's urine, with the following result:—Clear, amber coloured, acid in reaction, specific gravity 1,020, phosphates present, *no albumen.*

On the same day Drs. Ross, Sanders, Dyson, Tomes and Vaughan examined the house in which Cotta had lived previous to his removal to hospital. It is a small cutcha-pucka house, with cramped rooms, involving constant contact in its inhabitants. It had not been fumigated or disinfected or white-washed up to that date. Cotta's sister and the other people living in it evinced no fear of infection from living in it, and ridiculed the idea. In the same mohulla (Punchanuntollah) a case of plague had been reported that morning, and was immediately inspected by the doctors named above.

The patient was a Mussalman child, a little more than one year old. It had an enlarged gland in the right armpit, and a smaller one in the groin on the same side. Its temperature was 106°. It was said to have been ill for five days. The child did not appear to be suffering any great physical inconvenience, and its eyes were clear and bright, and the expression of the face cheerful. A local practitioner, who was standing by, stated "that it was by no means uncommon for people to get enlarged glands and fever in Howrah at the end of the rainy reason."

Remarks.—Reviewing the case of Cotta, the only reason for supposing that he is suffering from plague (*Pestis ambulans?*) is the fact that plague bacilli have been found in his blood. I am not skilled bacteriologist enough to decide whether they are the real bacilli or not, and would like the opinion of some other bacteriological expert, say Dr. Cunningham. On the other hand, we have a clear history of venereal infection with the enlargment and final suppuration which is so commonly a sequel. He has never suffered from any other symptoms resembling plague. His appetite has been good. His tongue is clean after nearly a month's illness; he has never suffered from frontal headache, delirium, high fever, hæmorrhage, or epistaxis, injection of the conjunctivæ; the enlarged glands have never caused severe pain; in fact, he has had none of the classical symptoms of plague. I am aware that there is a very mild form of plague called the "ambulatory form," in which the symptoms are of the slightest. This form of disease is generally held to be non-infectious.

With regard to the native practitioner's statement, that at certain times of the year people in Bengal suffer from enlarged glands, the remarks of Surgeon-Colonel May, A.M.S., in his Annual Return for 1895 possess great interest.

He says:—"There were 43 admissions for disease of the lymphatic system, of which 37 were for inflamed lymph glands of the groin. It would seem that there must be some climatic (malarial?) influence at work in the production of this disease, as it is of such frequent occurrence, and no other cause is assignable; many of them run a long course, and have to be scraped or removed before recovery takes place."

The above statement indicates that extreme caution should be exercised before the mere existence of enlargement of the inguinal gland should be regarded as pathognomic of plague.

Telegram, from Dr. Sanders, Howrah, to Hospitals, Bengal, Darjeeling, dated 11th October 1896.

Have seen Cotta; a typical case syphilitic buboes; no fever. No cause for alarm.

Letter from—Surgeon-Lieutenant-Colonel Sanders, 36, Chowringhee, dated the 11th October 1896.

Dear Dr. Ross,

I got your telegram this morning at 10 A.M., and at once went to Howrah. I saw and carefully examined J. Cotta.

History.—He lived with his parents in the Byculla quarter of Bombay, said to be three miles from Mandvi: he never went to Mandvi.

He left for Calcutta on September 23rd and travelled in the same carriage with his sister and her children, arriving at Calcutta on the 26th. The sister and the children have remained perfectly well. On October 2nd he went as an out-door patient, giving the assumed name of Maddox, to the General Hospital at Howrah.

The Assistant Surgeon, Mr. Mitchell, found that he had a sore on his penis and buboes. He gave him black wash for the sore, and I forget what for the buboes (*Cotta's statement*). On October 7th he applied for admission to the hospital as an in-door patient, and said his sister would pay for his keep. He was told to get a letter from his sister, and went away, not returning to the hospital. On October 8th a police report was sent that there was a suspicious case of fever with buboes. This Mr. Cotta was then examined by Dr. Tomes first, and then by Dr. Tomes, Dr. Cobb and Dr. Simpson; and they pronounced the disease to be bubonic plague.

Present condition : Sunday, October 11th.—Found dressed and sitting in a chair, no fear, no symptoms of having been ill. Temperature normal. Pulse quiet and regular.

Tongue clean, appetite good. On each side of the abdomen above Poupart's Ligament, a large bubo, one on either side, larger on the left than the right, no sign of suppuration, and but very little pain on pressure. Admits having been with girls in Bombay, and to have had a sore first, followed by these buboes.

On the inner side of the arms and on the front of the fore-arm, on the right side, a very suspicious rose rash, faint when seen by me, but stated by his sister to be much more marked when he gets warm. It looks very like a commencement of the rash secondary syphilis.

I am sure the case is nothing more than an ordinary bubo, following a chancre on the penis.

I have never seen a case of plague, but I am sure I cannot be mistaken in an ordinary case of syphilitic bubo.

If any case of plague is reported, I will personally see it and wire you the result.

P.S.—I am willing to take all responsibility for this report, and to treat the man in the Mayo Hospital.

Letter from Surgeon-Lieutenant-Colonel Sanders.

Dated 11th October 1896, 11-30 A.M.

J. Cotta lived with his parents in the Byculla quarter of Bombay, said to be three miles from Mandvi. He left for Calcutta on September 23rd, and travelled in the same carriage with his sister and her children, arriving at Calcutta on the 26th September. On 2nd October he went as an out-door patient, giving the assumed name of Maddox, to the General Hospital at Howrah. The Assistant Surgeon Mr. Mitchell, found that he had a sore on his penis and buboes. He gave him black wash for the sore and I forget what for the buboes. On October 7th he applied for admission to the hospital as an in-door patient, and said that his sister would pay for his keep. He was told to get a letter from his sister, and went away and did not return to the hospital.

On October 8th a Police report was sent that there was a suspicious case of fever with buboes. This Mr. Cotta was then examined first by Dr. Tomes and afterwards by him in company with Drs. Cobb and Simpson, and they pronounced the disease to be bubonic plague.

Demi-official from Surgeon-Major R. Cobb, Officiating Surgeon Superintendent, Presidency General Hospital, to the Inspector-General of Civil Hospitals, dated Calcutta, the 15th October 1896.

The first case I saw was Cotta. Dr. Simpson and I examined the blood and found characteristic diplo-bacteria similar to those described in works on Bacteriology and exactly like those in Dr. Simpson's possession from Bombay.

They were also found in the serum drawn from the gland.

2. Similar bacteria were found in the blood in the case of Gertie Hodges, who had glandular enlargements with fever.

3. Also in the case of the boy Heman Shah.

P.S.—Dr. Simpson had the notes, so I was unable to reply to yours at once.

From Surgeon-Major A. Tomes, Officiating Civil Surgeon, Howrah, to the Magistrate of Howrah, dated Howrah, the 12th October 1896.

With reference to your letter of yesterday on the subject of Mr. Cotta's illness and Dr. Sanders' opinions, I am still strongly of opinion that the case is one of pestis ambulans, the mild form of plague.

Dr. Cobb, Dr. Simpson and myself thoroughly examined the young man, having specially in view at the time any possibility of syphilis, and after careful consideration came to the conclusion that the case was not one of syphilis.

I may mention that at the commencement of plague medical men have at times mistaken the glandular swelling in the groin for syphilitic buboes, and in this case Dr. Sanders appear to have fallen into that error.

I feel it is my duty to warn you that this case is not syphilis, but plague, and that if the patient had not been isolated, he would be a danger to the community.*

Memo. by Surgeon-Major A. Tomes, Civil Surgeon, Howrah, dated Calcutta, the 12th October 1896.

Copy forwarded to the Sanitary Commissioner, Bengal, for information.

Telegram from The Inspector-General of Civil Hospitals, Bengal, to His Honour the Lieutenant-Governor, dated Calcutta, the 15th October 1896.

We have examined four reported plague cases. In our opinion, Howrah case is venereal bubo, one child, Howrah, abscess in armpit. In Manicktolla two cases ordinary fever. No case has any clinical appearance of plague. Letter follows.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, and Secretary of the Howrah General Hospital, to the Inspector-General of Civil Hospitals, Bengal, No. 999, dated Howrah, the 15th October 1896.

I have the honour to report that there is no fresh case resembling bubonic plague in Howrah, and all necessary precautions are being taken.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, to the Inspector-General of Civil Hospitals, Bengal, No. 1004, dated Howrah, the 16th October 1896.

I have the honour to report that there is no fresh case resembling bubonic plague in Howrah, and all necessary precautions are being taken.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, to the Inspector-General of Civil Hospitals, Bengal, No. 1005, dated Howrah, the 16th October 1896.

Since my arrival here on Tuesday, I have done my best to become acquainted with the history and symptoms of the case of Mr. Cotta. He arrived in Howrah on the 26th September. On the 28th September he suffered from "fever" and then attention was called to the fact that he was also suffering from large buboes in both groins. There is a history of unclean coition and the appearance of some small sores on the prepuce about the 16th September. Mr. Cotta left Bombay on the 23rd September, and at that time the glands in the groin were somewhat enlarged.* In the same railway carriage there travelled his sister and other persons. These persons have shown no signs of illness, nor is there any evidence that any of them had been exposed to the danger of plague contagion in Bombay. A boy of about ten years of age has been in close attendance on Mr. Cotta both in the plague hospital and in the isolation ward of the

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* Note.—The Board did not call this a case of syphilis, but called it a case of venereal infection.

Howrah General Hospital. This boy is in excellent health. I cannot here enter into details, but I have very good reason for considering that the case is not one of *Syphilis.* So far, and in the absence of other evidence, I should at once accept these buboes as the result of infection from *venereal sores, and no* question of the "bubonic plague" would exist. The Health Officer of Calcutta examined the patient's blood, and in it he found a variety of diplococcus resembling, though perhaps not identical with, the micro-organisms found in the cases of plague in Bombay. I have been able, through the courtesy of Dr. Simpson, to examine a number of slides, including specimens from Bombay. I am also acquainted with the drawings made of the bacillus found by Yersin in cases in Hong-Kong. Although, from a clinical point of view, I am inclined to believe that no case of true virulent bubonic plague has as yet appeared in Howrah, I think that in Mr. Cotta's case further independent bacteriological researches should be made. Mr. Cotta's case may be, as I have seen stated, a mild case of "pestis ambulans," but whether identical with the plague, as I understand that disease, has yet to be proved. The ways of the bacteriologist are full of difficulties, and we may be dealing after all with some new form of disease.* One point is, I think, clear, that there is no occasion for any panic, and that any attempt to make the people over-anxious is to be deprecated. At the same time, so long as the plague continues in Bombay, the same care should be taken to detect and prevent it in Calcutta. It is better even to err on the side of over-carefulness. Mr. Cotta is doing well, the buboes will in course of time suppurate, and the final treatment will be surgical.

* Mr. Cotta's case in some of its aspects resembles mild cases reported from Yunnan.
J. H. W.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, and Secretary of the Howrah General Hospital, to the Inspector General of Civil Hospitals, Bengal, No. 1010, dated Howrah, the 17th October 1896.

I have the honour to report that there is no fresh case resembling "bubonic plague" in Howrah, and all necessary precautions are being taken. Mr. Cotta is doing well.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, to the Inspector General of Civil Hospitals, Bengal, No. 1013, dated Howrah, the 18th October 1896.

I have the honour to report that there is no fresh case resembling "bubonic plague" in Howrah, and all necessary precautions are being taken. Mr. Cotta is doing well. This morning it was reported to me that a syce in the employ of a European gentleman in Howrah was suffering from plague. I visited the case at once, and found the man suffering from gonorrhœa with orchitis.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, to the Inspector-General of Civil Hospitals, Bengal, No. 1023, dated Howrah, the 20th October 1896.

I have the honour to report that there is no fresh case resembling "bubonic plague" in Howrah, and all necessary precautions are being taken. Mr. Cotta is doing well. Specimens of blood were taken this morning for examination by Brigade-Surgeon-Lieutenant-Colonel D. D. Cunningham.

16th.—Have again inspected all cases. All doing well, except Heman Shah; weak, but no fever or bubo.

20th.—Cotta was put under chloroform and the left bubo was incised, and four cultivations and two slide preparations of his blood were taken.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, to the Inspector General of Civil Hospitals, Bengal, No. 1027, dated Howrah, the 21st October 1896.

I have the honour to report that there is no fresh case resembling "bubonic plague" in Howrah, and all necessary precautions are being taken. Mr. Cotta is doing well. Kindly let me know if he may be removed from the isolatio[illegible] ward.

From Surgeon-Captain H. J. Dyson, F.R.C.S., Sanitary Commissioner for Bengal, Acting Secretary to the Medical Board, to the Civil Surgeon of Howrah, dated Calcutta, the 23rd October 1896.

With reference to your letter No. 1027, dated the 21st instant, asking for instructions as to whether Mr. Cotta, who is said to be doing well, may be removed from the isolation ward, I have the honour to say that in a matter of this kind you should use your own discretion.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, and Secretary of the Howrah General Hospital, to the Inspector-General of Civil Hospitals, Bengal, No. 1030, dated Howrah, the 22nd October 1896.

I have the honour to report that there is no fresh case resembling "bubonic plague" in Howrah, and all necessary precautions are being taken. Mr. Cotta is doing well.

From Surgeon-Major J. H. T. Walsh, Officiating Civil Surgeon, Howrah, to the Inspector General of Civil Hospitals, Bengal, No. 1040, dated Howrah, the 24th October 1896.

I have the honour to report that there is no fresh case resembling "bubonic plague" in Howrah, and all necessary precautions are being taken. After a careful study of the history of Mr. Cotta's case, I have decided that it was not a case of "bubonic plague." I have removed him from the isolation ward, and his name will not in future appear in these reports. With your permission these reports will cease until a suspicious case does occur.

CASE NO. II.—REPORTED CASE OF PLAGUE AT CHATAWALA GALI.

Reported cases of plague which have not been seen.—It was reported that the daughter of an officer in the Preventive Service was suffering from plague, and that bacilli were found in her blood. The parents declined to allow her to be sent to the Isolation Hospital. The following letter from Dr. Panioty throws some light on the case. He writes to the Secretary of the Mayo Hospital as follows:—

"Sir,—With reference to your letter No. 81, dated 5th October 1896, requesting me to inform the Surgeon-Superintendent of any suspicious case, I have the honour to submit for his information the following facts, as the newspaper reports are not correct, regarding the girl Gertie Hodges of Chatawallah Gali. I have seen Dr. Ferris about the case, and he informs me that when he saw the child on Saturday morning, the 10th instant, there was no fear, and that the child was apparently in as good health as anybody. He did not pronounce the case to be one of *mumps*, and he told the mother that the child did not want any treatment, as the mother informed him that the swelling had subsided a good deal, and that she painted the neck with belladonna, as the iodine with which she had painted the neck caused the child some pain. Exactly the same symptoms were noticed here. When the child was brought here on the 9th October last, there was no fever, the child was in good health, only that the submaxillary and cervical glands were somewhat enlarged. Belladonna was painted and some medicine given, and the child has never been brought here any more, although the papers say she was brought here on Sunday morning. I examined the child, and beyond these symptoms noted there were signs of inherited syphilis, such as well-marked Hunterian teeth, enlarged cervical glands, etc. When the Medical Inspector called on me on the afternoon of the 9th instant, I mentioned the case to him, not as any suspicious case, but one into which he may look, owing to the unhealthy locality from where the child comes. I even told the Medical Inspector that two or three years ago I had treated the sister for syphilitic sore of one of her legs."

Bacilli were found in the blood by Drs. Cobb and Simpson.

CASES NOS. III AND IV.—A REPORT ON THE CASES OF PLAGUE IN THE MANICKTOLLA ISOLATION HOSPITAL OF CALCUTTA.

On the 13th of October Drs. Ross, Sanders, and Dyson inspected the Manicktolla Isolation Hospital. Dr. Simpson was invited to attend, but was unfortunately unable to do so, as he did not get the letter in time.

The spot selected for the hospital appears a suitable one, and the erection of hospital sections is being rapidly carried out. There are two native doctors living in the enclosure, in tents, and a small brick building is utilized as a temporary hospital. It contained two cases, one, named Tin Cowry Charan Pal, the other Heman Shah.

Tin Cowry Charan Pal is a Hindu boy and works in a jeweller's shop, and is thus brought considerably into contact with Marwaris. He has no history of any accident which might cause enlargement of the glands.

Previous history.—Had lymphatic swelling of the right thigh nine or ten years ago, forming deep-seated abscess, which had to be operated on. In 1895 was first affected with cholera, and then with small-pox; for the last two years since he began to work, he has now and then suffered from fever, cold and swelling of inguinal glands. On the 5th he was attacked by fever, and next day had slight swelling of the inguinal glands, which were a little tender; he was treated for fever. Dr. Cobb and Dr. Simpson examined his blood and found bacilli. He was admitted into the Isolation Hospital on the 11th with a temperature of 103°. On the 12th it was 100°, and on the 13th normal. He was found to be a fairly well-nourished boy of a cheerful appearance, with a clean tongue and clear eyes—no headache. The inguinal glands were slightly enlarged, but not markedly so. His tongue was clean, and he had no other symptoms.

Heman Shah, a boy, is by trade a hawker, and therefore exposed to all vicissitudes of temperature and climate. He was attacked on the 10th, and bacilli were found in his blood. When seen at hospital on the 13th, his temperature was 102, face a little sunken, breathing slightly quickened, eyes clear, no headache, tongue bright red, with the papillæ enlarged and prominent. He has gurgling in the iliac fossæ; the inguinal glands are practically not enlarged. He has symptoms of commencing pneumonia in the left lung, and the rise of temperature may be due to it. He presents the appearance of an ordinary fever case.

Remarks.—If Tin Cowry Charan Pal's case is one of plague, it certainly is a wonderfully mild form. He acquired fever on the 5th, and two days after admission into hospital, where he is carefully treated and fed, is free from fever and practically has no buboes.

It was decided at a meeting of the Corporation, the Board of Health being present, that these two cases might be discharged from hospital.

CASES NOS. V AND VI.—THE SUSPICIOUS CASES IN THE PRESIDENCY GENERAL ISOLATION WARDS.

On October 17th, Drs. Ross and Dyson visited the Presidency General Hospital to examine two people who have been placed in the infectious wards as suspicious cases. They are respectively a small male child and a young man. Their histories are as follows:—

The child, 3 years of age, was born in Sylhet, and has repeatedly suffered from attacks of malarial fever. He has slightly enlarged glands under the jaw and in the armpits and groins, and has also inflamed tonsils. The glands are apparently not tender to the touch. His temperature on Thursday, the 15th, rose to 102°. Present condition: no marked distress in the face; tongue clean; conjunctivæ morbidly white and glistening; no enlargement of the spleen. The child appears to have a scrofulous diathesis. No other symptoms of plague.

The young man, Douglas, is a bridge inspector; he states that he strained himself on the 23rd September, and found the glands of the left groin were slightly enlarged on the 26th. Five glands in all were enlarged. He continued his work, and walked regularly 2 to 2½ miles daily. He found that walking made the glands worse. He was admitted into hospital on the 13th October. He then had five enlarged glands; there are now only two, neither are markedly tender. His temperature has for days been normal. He is a poorly nourished man, with a thin face. His eyes are bright and clear and he makes no complaint of headache. He has had blood abstracted for bacteriological purposes by Dr. Cobb, but the result is not known. He has been in the infectious ward two days. He looks as if he needed feeding up, otherwise seems healthy enough and comfortable.

The child has left the hospital some days ago; the other case remains under treatment.

CASE NO. VII.—CASE OF PLAGUE REPORTED IN KIDDERPUR.

From SURGEON-CAPTAIN H. W. PILGRIM, M.B., Officiating Civil Surgeon, 24-Parganas, Alipore, to the Secretary, Health Committee, c/o Inspector-General of Civil Hospitals, United Service Club, Calcutta, No. 1123, dated Alipore, the 22nd October 1896.

With reference to your Circular No. 47, dated 16th instant, I have the honour to state that the Police asked me yesterday afternoon to examine a girl 3 or 4 years of age, by name Annoda, residing at Pearatolla, beyond Garden Reach; the case was said to have been reported by a native practitioner, Girish Chunder Ghose, as being a case of plague. I went and examined the child, who had been suffering from slight fever, and now has a few of the cervical and occipital glands enlarged. There was nothing in the symptoms or condition of the child beyond the slight enlargement of the glands, so common in children, to even remotely suggest the presence of plague.

CASE NO. VIII.—CASE OF PLAGUE REPORTED IN RAJA RAJBULLUB'S STREET.

Extracts from the Commissioner's Report Book, 1st Division Town, Section A, Shampookur, Case No. 4418 of the 4th November 1896.

At 10 A.M. one K. M. Mukerji of No. 252, Upper Chitpur Road, informed by a letter that one Bipin Behari Dutt is suffering from glandular fever at No. 1, Raja Rajbullub's Street. Medical Inspector at once informed.

Case No. 4446 of the 5th instant.

Referring to case No. 4418 of yesterday's date, the Medical Inspector informed that he, together with Drs. Simpson and Cobb, saw the patient last night, and that they suspect it to be a case of bubonic plague, but they would not give any opinion until satisfied with microscopical examination. The patient died in their presence, and the place had been properly disinfected.

No. 10638, dated Calcutta, the 6th November 1896.

Memo. by C. B. DRAKE-BROCKMAN, Esq., Officiating Deputy Commissioner of Police.

Forwarded to the Secretary to the Medical Board for information.

From W. J. SIMPSON, Esq., M.D., Health Officer, Calcutta, to the President of the Medical Board, dated Calcutta, the 15th November 1896.

I have the honour to report a death from plague, which took place at 6-30 P.M., on November 3rd. Information was given to me about 4 P.M. on November 3rd, and the case was visited by Dr. Cobb and myself at 5-30 P.M. The patient died in our presence at 6-30 P.M., and as the friends would not give permission for a *post-mortem* examination, I ordered the Medical Inspector to accompany the body to the burning ghât, and to see personally that it was burnt along with the infected clothing. It was impossible to inform the Medical Board in time in order that the medical members should see the case, owing to the man's rapid death. An attack of illness prevented me from reporting the case the next day, but I verbally told Dr. Dyson about it in the morning, and he expressed his intention of making a local enquiry.

The details are as follows:—

History.—Bipin Behary Dutt, aged 32 years, a sugar-candy maker, residing at No. 1, Raja Rajbullub's Street, is stated to have been seized with a sudden attack of headache, fever, pain, and enlargement of the glands of the right groin on November 1st. The pain in the groin became so severe that he was confined to bed and could not straighten his leg. The symptoms increased in severity, and on November 2nd, about 3 P.M., the headache became intense and the abdomen swollen. At 8 P.M. he became insensible. Dr. K. M. Mukerji states that he was called in at 10 P.M. on November 2nd and found the patient in a comatose condition, picking at the bed clothes and in high fever, with congested eyes. The glands in the right groin were enlarged. He informed the friends that the case was a hopeless one, and the next morning sent a post-card to the Health Officer reporting the case. Another medical man, Dr. Chatterjee, was called in later, and it is stated found the temperature to be 104°. The patient is said to have scalded his toe more than a fortnight ago, but we found no marks on the foot.

Condition on examination by Dr. Cobb, Dr. Mittra, and myself.

The patient was lying insensible, breathing with a sighing and moaning noise. The eyes were sunken and the conjunctivæ very much congested. The direction of the eyes was upwards and to the right. The pupils were contracted and insensible to light. The tongue was furred in the centre and red at the tip and edges. Pulse was 160 and respirations

32 per minute. The body, especially the head, face and legs, was covered with a profuse perspiration. Petechiæ in large numbers were to be seen on the chest and abdomen, and a few on the back, arms, and legs. They varied in size from $\frac{1}{10}$th to $\frac{1}{4}$ inch in diameter, and did not disappear on pressure. Both the inguinal and femoral chains of lymphatic glands on the right groin were enlarged. Two of the former and three of the latter were felt to be swollen. In the inguinal region the largest was the size of a boy's marble, and in the femoral that of an almond. Blood was taken from the enlarged femoral gland and from the medium basilic vein. Microscopic examination showed diplobacteria.

Notes on a case of reported true Plague seen by Drs. Cobb and Simpson on Tuesday, the 3rd instant.

We were informed yesterday, the 4th instant, that a case of true plague had been detected at No. 1, Raja Rajbullub Street, on the 3rd instant (afternoon).

The case was seen and reported by Drs. Cobb and Simpson.

No intimation was officially given to the Board of Health until the 5th instant, and this despite the distinct orders upon the subject laid down in paragraph 5 of Government Resolution No. 937T., dated 10th October 1896.

Having received information from the Hon'ble H. H. Risley, C.I.E., privately on the 4th instant, we visited the house at once in company with the Ward Medical Inspector (Dr. Mittra).

We found that the room had been disinfected and washed out with carbolic lotion, and that MacDougal's disinfecting powder had been profusely strewn on the floor and in the court-yard. The roof had apparently not been touched and the wood-work showed no signs of having been washed down. Several apertures in the room had not been properly closed up, and sulphur has ceased to burn (18 hours after death).

The body was cremated, and all clothing and furniture had been burned under the personal supervision of the Ward Medical Inspector (Dr. Mittra).

Statement made by the employer and by the friends of the patient.

The deceased, Bipin Behary Dutt, was in the employment of a sugar-candy merchant. It was stated that the patient's right big toe had been scalded about a fortnight before his illness commenced. He had done his work as usual, and the effects of the scald had not caused any perceptible lameness, and he was able to walk about, and he never complained of having enlarged glands. On Saturday, the 1st instant, he was unable to go to work, and the reason given was that he was suffering from fever.

Statements by the medical practitioners who saw the case.

On Monday night the family physician, Dr. Mukerji, a homœopathic practitioner, was called in at 10 P.M. He found the patient unconscious, and his temperature was about 104°F. His attention was also drawn to the enlarged glands in the groin. Knowing that bubonic plague was suspected to be in Calcutta, and associating the enlargement of the glands with the high temperature and coma, he formed the opinion that it was a case of bubonic plague. He communicated his suspicions to the Police, and eventually Drs. Cobb and Simpson visited the patient. This homœopath stated that he did not notice any petechiæ, but saw a piece of cloth with some native drug on it applied to the enlarged glands. He also stated that had he had no suspicion of bubonic plague, he would have thought that this case was one of typhus. He evidently did not think there was any difference between typhoid and typhus.

It will be noticed that there was almost an interval of 20 hours between the time when the homœopath first saw the case and when it was visited by Drs. Cobb and Simpson.

He sent a post-card to the Health Officer, reporting the case as one of plague. Dr. Chatterji (an allopathic practitioner) visited the case about half-an-hour after Dr. Mukerji had left, and he gave us the following information:—

That a friend of the deceased's (a cooly) had told him that the glands in the right groin had been enlarged for about 8 or 10 days before the commencement of the illness. He noticed the plaster in the right groin, and found a small ordinary bubo, which had not suppurated, underneath it.

The patient was in a comatose state, and was suffering from fever.

His opinion was that the case was one of low remittent fever; and as the glands had been enlarged for more than a week, it never struck him that the case could be one of plague. He saw no petechiæ on the body. He found five or six coolies attending the patient and putting ice on his head; also that he did not think he would be able to recognise the cooly who gave him the information about the bubo. Having elicited this information from Dr. Chatterji, we returned to No. 1, Raja Rajbullub Street and endeavoured to discover the cooly mentioned above. By this time the employer and his servants were in a considerable state of apprehension, and were unanimous in stating that practically nobody attended the patient except very intermittently, and that the greater part of the nursing was carried out by outside agency. We felt that under the conditions it was hopeless to expect to elicit any further information. We also visited Dr. Mukerji's dispensary, but he was out. He subsequently came to us in the afternoon, and his statement is recorded above.

Dr. Mukerji and Dr. Mittra are making enquiries as to where the materials for making the plaster were got from, and when it was applied to the enlarged glands. They are also trying to obtain information regarding the previous history of the case from the deceased's friends.

Further report on the case of "true plague" reported by Drs. Cobb and Simpson.

On the 6th we proceeded to No. 1, Raja Rajbullab Street, and found Babu Nolin Behari Sircar waiting for us.

After a good deal of difficulty and hunting about we managed to find the friend (Behari Lal Das) who had attended the deceased (Bepin Bihari Dutt) during his last illness, and he furnished us with the following particulars:—

I am an intimate friend of the deceased's. I often met him, and I know that he led a fairly loose life. I had not seen him for ten days, when he sent for me on Saturday, the 31st ultimo. He was quite well the last time I had seen him. On visiting him I found that the patient was unable to go to his work. He was unable to walk by himself, so I was obliged to carry him to the latrine, and then I noticed that he was loosened. I noticed that he was suffering from double orchitis, and the parts were swollen and red, and were painful to the touch, and the glands in his right groin were slightly enlarged, but they were not very tender. He had slight fever on Saturday evening. The patient scalded his right great toe with some boiling sugar five or six days before I saw him, and this laid him up temporarily. After four days he was able to limp about, and he returned to his work. It was after this that he suffered from double orchitis.

On Monday the 2nd instant, he got very much worse, and he sometimes clenched his hands. I noticed that he had small red spots on his body, and when I asked him how they had come there, he said that there were too many mosquitoes about.

At this point Babu Nolin Behari Sircar pulled up one of his sleeves and showed us some red spots (mosquito bites) that were on his arm, and on being asked if the spots resemble those on the deceased's body, Bihari Lal Das said that they were exactly the same.

The mosquito bites on Babu Nolin Behari Sircar's arm did not disappear upon pressure.

He continued:—I attended to the patient from Saturday.

On Monday he became delirious, but before he got into that state he expressed a strong desire to return to his native village.

I noticed that there was a plaster on the enlarged glands: it was there when I first saw the patient, but I do not know where he got it from.

I went on Sunday and Monday to see him, and stayed with him all Monday night.

On Tuesday I remained with him till 11 A.M., and returned again at 5 P.M.

I was present when the doctors came on Monday night but I did not inform them about the double orchitis. I did not notice any yellow stains on his *dhotee*, and I am not aware that he had venereal disease. All the occupants of the house and the coolies employed by the sugar refiner knew of his condition, but none of them informed the doctors of the truth, and they must have lied to the *sahibs*.

Babu Nolin Bihari Sircar states orchitis is not uncommon, but never produces fatal results.

CASE NO. IX—CASE AT WOOLTADANGA.

From W. J. SIMPSON, Esq., M.D., Health Officer to the Corporation of Calcutta, to the President of the Medical Board, No. $\frac{B}{108}$, dated Calcutta, the 6th November 1896.

I have the honour to inform you that the following post-card has been received by me to-day:—

"From Babu JOHAR LAL DUTT, to Dr. SIMPSON, dated Wooltadanga, the 4th November 1896.

"There occurred a case of bubonic plague in Wooltadanga Saltpetre Factory. The man died yesterday at No. 42-24, Wooltadanga Road. You ought to see if it is plague or not."

I have sent a Medical Inspector to make enquiries and hasten to give you the information, in order that the Medical members of the Board may make enquiries if they desire to do so.

From W. J. SIMPSON, Esq., M.D., Health Officer to the Corporation of Calcutta, to the President of the Medical Board, dated Calcutta, the 7th November 1896.

In continuation of my letter dated yesterday's date, I have the honour to forward herewith a copy of the Medical Inspector's report on the Wooltadanga case.

I do not remember this.
H. H. R.

HEALTH OFFICER—

With referrence to the alleged case of bubonic plague reported to you by one Johar Lal Dutt, I beg to state that I had been to the saltpetre factory at 45-25, Wooltadanga Road, this morning.

It is on the other side of the canal, and is outside our jurisdiction. The deceased, name Goorbuksh Laul Hinon, male, about 60 years old, had been laid up for 13 days. At first he had been suffering from obstinate constipation and pain in the abdomen.

Then he had persistent hiccough for five days. Subsequently he became speechless three days before his death on the 3rd November. There was no enlargement of any of the glands, nor any other suspicious symptoms. These are all the facts I could gather.

INTESTINAL OBSTRUCTION.

H. D.

From W. J. SIMPSON, Esq., M.D., M.R.C.P., Health Officer to the Corporation of Calcutta, to the Secretary to the Board of Health, No. 114 B., dated Calcutta, the 16th November 1896.

With referrence to your letter No. 11, dated the 12th November 1896, I have the honour to refer you to the Medical Inspector's report, which was forwarded to the Board on the 7th instant, and which states that from enquiries he did not think that the man who died at 42, Wooltadanga Road, was a case of plague, and, secondly, it was beyond the limits of the Municipality of Calcutta. For these reasons the matter was simply reported to the Board and no action taken.

CASE NO. X.—CASE IN ARMENIAN STREET.

From W. J. SIMPSON, Esq., M.D., Health Officer, Calcutta Municipal Corporation, to the President, Medical Board, No. 113B., dated Calcutta, the 10th November 1896.

I have the honour to submit the following report on a case of pestis ambulans and on an unusual mortality among rats:—

Case of Giga, aged 4 years, son of Hardat Roy, of 13, Armenian Street.

Dr. Charles wrote to me on October 30th to the effect that he had just seen in consultation with Dr. Billimoria a case which he thought ought to be examined. The details given by Dr. Charles are as follows:—"Child Giga, aged 4 years, son of Hardat Roy, of 13, Armenian Street, ill about ten days, fever and slight bronchial catarrh, glands of left axilla enlarged to size of small marbles; those of right axilla enlarged, but less so; glands of right groin palpable; one gland in left groin inflamed, and will suppurate, sub-occipital glands can be felt, but do not count, as the child has had eczema of auricles. The definite clinical signs of a typical case of plague not there, but I consider it certainly as good a case as I can imagine for the examination of the blood.

Present condition.—Fever continuous with exacerbations, bronchial catarrh, glandular enlargements, tenderness on pressure over liver, a vesicular and popular rash has been out; not seen to-day.

On October 31st I visited the house in company with Dr. Billimoria, and found the patient in the same state as noted above. His temperature on the 30th October was 101·8 in the morning and 100 in the evening. On 31st October temperature 99°4, pulse 120, tongue furred in the centre, tip and edges red, bowels inclined to be constipated.

On November 1st the patient was seen by Dr. Cobb, Dr. Billimoria, Dr. Chatterjee and myself.

The gland in the groin was opened and found to contain pus. Specimens of blood and pus were taken.

The blood on examination was seen to contain diplobacteria.

On enquiry into the circumstances of the case we found that the people in the house were Marwaris, who had communications with Bombay and received goods (clothing and yarn) from that city.

After having completed our examination of the patient we went down stairs to inspect the godowns where the bales from England and Bombay were stored. While inspecting these we noticed a large grey rat sitting on a step looking very ill, it had a staring coat, watery eyes, and did not attempt to move though surrounded by people. The rat was caught and taken to the laboratory, where it was killed and immediately examined.

Post-mortem examination of the rat.

On deflecting the skin from the abdomen and groins, two enlarged glands, the size of small beans, were found in the right groin. In the left groin two glands were found very much congested and agglutinated together.

In the left axilla was one enlarged gland, the size of an almond.

Lungs were a pale greyish colour, with dark mottled patches.

Spleen was congested and enlarged.

Abdominal glands were enlarged.

Kidneys were intensely congested.

Liver was enlarged and congested.

Blood was taken from the heart, liver, and spleen and examined under the microscope and found to contain diplobacteria. Blood from these organs was also put into nutrient media, with the result that pure cultures of diplo-bacteria were grown, closely resembling those found in the plague patients.

As a control experiment the blood, liver pulp and spleen pulp of 7 healthy rats were examined with negative results. Similarly, the blood and the spleen pulp of the healthy rats were put into nutrient media, and no growth of diplobacteria was found.

In connection with this observation I think it important to inform the Board that within the last few days an unusual sickness among rats in Jorabagan has been observed. Whilst the special establishment recently granted by the Municipal Commissioners for cleansing the premises of houses was working at 81, Burtolla Street, the Inspector of the gang noticed an unusual number of dead and sick rats. He reported the circumstance to Dr. Banks, who ascertaining the correctness of the statement on personal inspection reported the matter to me.

I visited the house with Dr. Cobb on the 9th November: we saw eight dead and two sick rats. 81, Burtolla Street, is a grain depot, and is in a very dilapidated and insanitary state, so much so that I have recommended it to be closed as unfit for human habitation.

The grain is brought from the Howrah Railway godowns and some of it is stated to have come from Bombay.

We next visited a neighbouring grain shop, 14, Burtolla Street. The owner at first stated that he had noticed an unusual mortality among rats, but he afterwards denied it.

Mr. Scott, one of the Inspectors of the special establishment in this locality, has lately observed a large number of sick rats in the streets with their hair partly or wholly fallen off. They creep about and are stoned by boys and sweepers, who make it a form of amusement. The two sick rats caught at 81, Burtolla Street, were taken to the Laboratory. One of them died shortly afterwards, and was not examined. No. 2 died at 3-30 P.M., and was examined at 4-15 P.M. The liver was found enlarged and congested, and spleen very dark in colour. Specimens of the spleen and liver showed diplo-bacteria in large numbers.

Later in the day (November 9th) 7 more sick rats were caught and sent to the Laboratory. Of these I forwarded two to Dr. Cunningham. One of the remaining five was killed and examined. The axillary glands on right side were much enlarged. The liver was enlarged. Specimens of blood, spleen pulp and liver pulp contained diplo-bacteria. The heart blood was put into culture media.

In consequence of the Board having recorded their opinion that the former cases of glandular swellings with fever reported by me were not cases of true bubonic plague, I hesitated to report the case Giga at 13, Armenian Street, though owing to my investigations at the Laboratory I satisfied myself they were cases of bubonic plague.

The occurrence, however, of a case of pestis ambulans at 13, Armenian Street, and the discovery at the same time and in the same house of a diseased rat containing diplo-bacteria in its blood and organs, combined with the subsequent unusual sickness and mortality among rats in parts of the town, have induced me to lay these facts before the Board. I consider these facts are of serious import as showing that the micro-organism of plague is gradually gaining a foothold in the city of Calcutta.

CASE No. XI.—CASE IN FORT WILLIAM.

Extract from a letter from DR. R. COBB, *to His Honour the Lieutenant-Governor of Bengal, dated 16th October 1896.*

Last July Surgeon-Major S——r, who had seen a large number of these cases (Plague), while on leave at Simla, was attacked by peculiar shiverings which he noticed were quite different from ague and were not followed by fever, but were followed by glandular swellings in the groin, axilla, elbow and neck: although better, he is still suffering from the effects of the attack: our examination of his blood showed the same bacillus.

CASE No. XII.—CASE IN WARRIS BAGAN LANE.

From W. J. SIMPSON, Esq., M.D., Health Officer of the Corporation of Calcutta, to the Secretary, Board of Health, dated Calcutta, the 12th November 1896.

I have the honour to forward you a copy of a letter just received (6-30 P.M.) from the Officiating Commissioner of Police.

" From H. PAGETT, Esq., Officiating Commissioner of Police, to the Health Officer of the Corporation of Calcutta, dated the 12th November 1896.

" I have the honour to inform you that one John Marcellies, of No. 13, Warris, Bagan Lane, cook's mate, died on the way to hospital this day.

" He had fever last night and swelling in the groin. His body has been removed to the Morgue in the Medical College Hospital. "

From SURGEON-CAPTAIN C. G. ROBSON-SCOTT, Secretary, Medical Board, to the Police Surgeon, Sealdah, Calcutta, No. 14, dated Calcutta, the 14th November 1896.

I am directed by the Medical Board to request the favour of your submitting a full report upon the *post-mortem* examination on John Marcellies, a cook's mate of No. 13, Warris Bagan Lane, who died on the 12th instant from suspected plague, and whose body was sent to the Medical College Morgue yesterday.

From SURGEON-MAJOR J. B. GIBBONS, Police Surgeon, Calcutta, to the Secretary to the Medical Board, Calcutta, No. 258, dated Calcutta, the 16th November 1896.

In compliance with your No. 14 of the 14th instant, I have the honour to forward a report on the *post-mortem* examination of the body of John Marcellies, together with a copy of the "particulars of cause of death as far as known," sent to me by the Superintendent, 2nd Calcutta Division, with the request to examine the body and furnish a certificate of the cause of death for the information and orders of the Commissioner of Police.

As the request reached me late on the afternoon of the 12th instant, I determined to make the *post-mortem* next morning. In the evening about 9 P.M. Dr. Cobb, accompanied by Dr. Simpson, Health Officer, came to my house to ask permission to take blood from the heart, and from them I learned that the case was suspected to be one of plague. As they were anxious to take the blood at once, and the case was apparently of no particular medico-legal importance, I gave the permisson, and they went on to the Morgue.

I held the *post-mortem* examination at 7-30 A.M. on the 13th instant in the presence of Drs. Bomford and Bird. Cover glass preparations were made by Dr. Bird from the enlarged saphena glands and from blood taken from the saphena vein in the middle of the leg.

Particulars of cause of death as far as known.

The deceased, aged about 16 years, lives at No. 13, Warris Bagan Lane. He was employed as cook's mate at the Great Eastern Hotel, and did not go to work yesterday, the 11th instant. At 7 A.M. yesterday he stated to Puna Lall Mug, his companion, who shared the same room as himself, that he had very strong fever and had swelling in his groin. Puna Lall Mug also states that his swelling on the groin was lanced about a year ago: the deceased's sister, Miss Jane Marcellies, and Pobi Bewah also speak to this fact.

He is a pauper, and was removed to the Medical College Hospital in a palki, and was accompanied by Edwin Pereira of 13, Warris Bagan, and on the palki landing at the hospital he was found dead.

On the 13th November at 7-30 A.M. I examined the body of a native male, aged about 17 years, identified by Corporal Abdul Latif to be that of John Marcellies *alias* Tootoo.

Body well nourished; *rigor-mortis* present in the legs only. Signs of decomposition—green discolouration of abdomen, superficial veins of a red colour, odour of putrefaction.

Three small, thin, old scars in the left femoral region. Left saphena glands enlarged. The largest a circular disc about the size of a rupee and ¼ inch thick; gland substance pale red in colour.

Lungs—old fibrous adhesions to the chest walls: substance congested. Bronchi filled with muco-purulent fluid and congested.

Heart—right side full of blood; endocardium stained by hæmoglobian; left side empty; muscle substance paler than usual; no valvular disease.

Liver—congested and greasy looking on section.

Spleen—soft and congested.

Kidneys—congested.

Stomach—healthy; contents about 4 ounces of watery fluid.

Intestines—healthy; contained bilious fœces.

Brain—vessels of meninges full; brain substance healthy. No marks of violence.

From the history of the case and the *post-mortem* appearances, I am of opinion deceased died of fever and bronchitis.

OTHER CASES IN FORT WILLIAM.

Demi-official from SURGEON-LIEUTENANT-COLONEL R. COBB, M.D., to His Honour the Lieutenant-Governor of Bengal.

I write to you on a most important and urgent matter which has come to my knowledge recently.

You remember the case of plague which occurred at Howrah on October 8th in a boy who arrived from Bombay. He suffered from glandular enlargements and a little fever, but was able to walk about.

Dr. Simpson and I examined him and took specimens of his blood, and submitted them to microscopical and bacteriological examination. We found bacilli in them identical with the plague bacilli.

When our certificate was published, it attracted the attention of Surgeon-Major S——r of the Station Hospital, who wrote on October 10th and gave me a history of the soldiers in Fort William suffering from buboes which he had long decided were not syphilitic, and he asked me to see a few of the cases with him.

On the 11th October I visited the Station Hospital and found these men to be suffering from a similar affection to that of the Howrah patient. On the same day I took specimens of the blood, and Dr. Simpson and I examined them together and saw they (*i.e.*, the bacilli) were similar in every respect to those found in the blood of the Howrah case.

In the meantime the Howrah bacillus had been cultivated and compared with the Bombay bacillus, and they, too, were found to be identical. After this Dr. Simpson and I, with the consent of Surgeon-Lieutenant-Colonel M——y and Surgeon-Major S——r, visited the Station Hospital on the 13th October, and examined ten of the patients very carefully, and found they were suffering from glandular enlargement of the groin, and many of them much pulled down from the effects of the disease. We took blood from the arms of two and transferred it immediately into culture media.

In three days characteristic growths appeared in some of the cultures, and a microscopical examination showed them to be the same bacilli as we had found in the Howrah and Bombay specimens. The next important point is that the Shropshire Regiment came from Hong-Kong, and, you will remember, the men were employed in cleaning out the plague-infected houses, and for that work they received a testimonial which they call the "Plague Cup." About this time, I am informed, two soldiers died of the plague, and whilst at Hong-Kong other soldiers began to be affected with glandular swellings in the groin and fever.

They came to Calcutta in January 1895, and ever since their arrival some of the soldiers have been laid up with this peculiar illness and glandular enlargements, new drafts of men being affected who had never been in Hong-Kong.

It was at first thought to be syphilis, and then careful consideration of the symptoms excluded this, and it was found that people who were above suspicion of syphilis got the disease.

Then it was considered to be of malarial origin, but malaria is not a disease which is of any particular prevalence in the Fort, and glandular swellings of this nature have never before been noticed in other regiments who have occupied the Fort previous to the arrival of the Shropshire Regiment, and, moreover, glandular enlargements are not a symptom of malarial poisoning.

Last July Surgeon-Major S——r, who had seen a large number of these cases while on leave at Simla, was attacked by peculiar shiverings, which he noticed were quite different from ague and were not followed by fever, but were followed by glandular swellings in the groin, axilla, elbow and neck: although better, he is still suffering from the effects of the attack: our examination of his blood showed the same bacillus.

A number of the men suffering from this disease have been, and are being, sent up to Jallapahar for the benefit of their health.

P.S.—Probably the mildness of the cases in the Shropshire Regiment is due to the fact that they have a bacillus of a declining epidemic, and also because they are surrounded by the best hygienic conditions, but this does not prove that they might not become very dangerous under other circumstances.

Dr. Cunningham subsequently repeatedly examined the blood of these cases and failed to find any typical bacteria.

With reference to these cases of non-venereal bubo, the accompanying article from the *British Medical Journal*, by Chas. C. Godding, furnishes interesting reading.

Surgeon-Lieutenant-Colonel May's note shows that non-venereal bubo existed among the troops in Calcutta in 1890, though the Shropshire Regiment did not arrive till 1895:—

On Non-venereal ubo, by CHAS. C. GODDING, M.R.C.S., *Fleet Sur n, H. M. S. "Centurion," Chefoo.*

(Communic by the Director-General of the Medical Department, R. N.)

nereal bubo, commonly spoken of as climatic or sy netic bubo, might be called lymphoma or adenoma. The disease is characterised by fever, enlargement of i uinal glands in one groin (seldom in both), increasing malaise and anæmia. The inguinal glands are invariably attacked; lymphatic vessels or glands in other situations never, marking the difference from lymphadenoma.

Etiology.—For many years I have been in the habit of associating these cases entirely with foreign service, and of calling them "climatic bubo;" but on looking up the "Health of the Navy" for the seven years 1888 to 1894 inclusive, I was greatly surprised at the total number of these cases, and also to find how many occurred in the Home and Irregular Forces. (See statistics.) This would be accounted for to a certain extent in the Home Force by cases occurring in men recently returned from abroad, and in the Irregular Force by its employment on almost constant foreign service.

I consider the disease to be primarily constitutional, as indicated by the fever, and the bubo as purely a local symptom, but how this constitutional condition is produced, or why the inguinal glands alone are invariably attacked, is difficult to ascertain; and though the large number of cases occurring in the Home and Irregular Forces militate against the name "climatic," yet climatic influences appear undoubtedly to play a considerable part in the causation of this disease. For instance, the East Indian Station gives nearly four times as many cases per thousand as the Mediterranean; and the China Station, where lymphoid diseases are common among the natives, comes next in order in the production of these cases, with three times as many as the Mediterranean. On the other hand, the Mediterranean, Australian, and West Coast of Africa give comparatively few cases, and are therefore climates non-provocative of this disease. I have myself seen the worst cases on the East Indian Station, at Zanzibar and adjacent coasts, the patients having huge masses of glands in the groin often suppurating, progressive anæmia and debility.

The immediate cause of the bubo appears to be: sometimes a slight sprain; at others superficial abrasion on penis or toes; while in some no apparent cause at all can be discovered; but in all these cases the presumed cause (or what the patient judges to be the cause) is quite insufficient to account for the long train of symptoms which follow, and are trivial accidents which would have been quickly recovered from, had not the patient been constitutionally ready for the excitation of this disease. Of eleven cases I have recently treated, four gave a history of slight sprain, in four no cause at all could be discovered, two had small superficial sores on penis, and one man a small abrasion on toe. In four of these cases the glands suppurated. Age has apparently no influence. Five cases occurred between the ages of 19 and 25; two between 25 and 35, and three in men over 35.

Statistics.—In the seven years from 1888 to 1894 inclusive, the average strength to the Royal Navy being 56,180 per annum, 733 cases of bubo was the yearly average. During the whole period twenty men have been invalided from the service, and nine have died, principally from exhausting suppuration from these buboes; in one fatal case femoral was ligatured.

The number of these cases varies considerably from year to year, but these figures show that the disease is a formidable one.

The worst stations are (1) East Indies, 31 cases per 1,000 of strength; China, 25; and West Indies, 22. Stations least affected are (1) Mediterranean, 8 cases per 1,000 of strength; Australia, 9, and West Coast of Africa, 13. The Home and Channel, with an average force of 27,000 men, gives 287 cases annually, or about 10½ per 1,000.

Symptoms.—In nearly all cases the patient's first and only complaint is simply the pain and swelling in the groin; he feels quite well in himself, but "the lump is getting larger." There may be a history of sprain or trivial injury, but almost as often there is no apparent cause. There is, however, a rise of temperature in nearly every case.

Course and duration.—The ordinary disease runs a fairly regular course of increasing fever and enlargement of glands, lasting two to four weeks, the resulting bubo being a large conglomerate swelling. Secondly, a decline of fever and resolution of glands, lasting about a similar period, and the whole covering a period of three to eight or nine weeks; severe cases, of course, lasting much longer. The eleven cases before referred to give an average of forty-four days' sickness; the shortest twenty-six, and the longest seventy-six days. I consider a cure effected in four weeks as very satisfactory. Frequently towards the end of the inflammatory stage, from fifteenth to twentieth day of sickness, the bubo becomes very boggy, and fluctuation is simulated very completely. I have never explored them to see if pus had formed. The buboes also vary from day to day, increasing or decreasing with exacerbations and decline of temperature.

Cases of Inflammation of Lymph Glands taken from the records in the Station Hospital, Calcutta.

From SURGEON-LIEUT.-COLONEL W. ALLAN MAY, A.M.S., Medical Officer in charge Station Hospital, Calcutta, to the Principal Medical Officer, T. D., Calcutta, dated the 22nd October 1896.

I have the honour to forward accompanying record of cases of inflammation of lymph glands, with a few short remarks which may be of use at the meeting of the Sanitary Board this morning.

Record of cases of Inflammation of Lymph Glands occurring in the Calcutta Station Hospital, from 1890 to 21st October 1896.

	1890.	1891.	1892.	1893.	1894.	1895.	21st October 1896.
1	2	3	4	5	6	7	8
Inflammation of lymph gland, cervical . . .	3	2	3	1	1	2	4
Ditto ditto, axillary . . .	1	...	...	...	...	1	1
Ditto ditto, inguinal . . .	27	39	26	38	19	39	41
Ditto ditto, femoral . . .	...	...	...	...	...	...	1
Ditto ditto, buccal . . .	1	..	...	...	...	...	...
TOTAL .	32	41	29	39	20	42	47
Total admissions for all diseases .	2,207	1,765	1,418	1,242	1,212	1,717	1,254

I.—1st Shropshire Light Infantry arrived from Hong-Kong, 8th January 1895, bringing two men suffering from inflammation of lymph glands and during the year 1895, 36 more cases occurred in this regiment, of which number *14 were in men who had not served in Hong-Kong.*

II.—In 1896 to date (21st October 1896) 47 cases have occurred. Of these, 41 can only be traced (the other 6 having left the station). Of these 41 cases, *23 occurred in men who had never been in Hong-Kong.* Of the remaining 18 cases, none of them had sufferd previously at Hong-Kong from inflammation of lymph glands.

III.—Of the 47 cases, 4 attacked men of other corps.

IV.—*No deaths have occurred from the disease.*

V.—In 1891 there were 41 cases. These occurred amongst the 1st East Kent Regiment and 21st So. Div., Royal Artillery—*neither having been in Hong-Kong.*

VI.—Of the 47 cases occurring in 1896 (to 21st October), in 8 there was the exciting cause of sore feet, and in 3 others *a possible* venereal taint.

APPENDIX No. XXII.

CLINICAL NOTES OF FIFTY CASES OF PLAGUE TREATED WITH YERSIN SERUM.

By Frank G. Clemow, M.D., D.P.H.

A summary of fifty cases of plague, treated in the Parel Old Government House Hospital, Bombay, by the injection of a serum prepared after M. Yersin's method, has already been submitted by me to the Indian Plague Commission. The following are the detailed clinical notes of these cases.

I have already, in submitting the summary, explained briefly the conditions under which the experiment was carried out, and I would only add here that the injections were for the greater part administered by Dr. Yassenski himself, the principal member of the Russian Plague Commission, by whom the serum was brought to Bombay from St. Petersburg; that during the period covered by the experiment the female cases were under the care of Miss Alice Corthorn, M.D., and that during my absence from Parel between 25th March and 4th April the hospital was in charge of Dr. Castellote, M.D.

All the patients submitted to the serum treatment were also submitted to the ordinary medicinal and other treatment practised in the wards at the time. In the following clinical notes the details of this treatment have for the most part been omitted: as to give them in one would have been misleading, and to give them in all would have involved unnecessary repetition. The treatment generally adopted was as follows:—The patient was kept strictly recumbent; this in the large majority of cases could only be done by tying the patient in bed with soft bandages. The diet in the acute stage was mainly restricted to milk and soda water, with rice, *dal* or sago *conjee* to those who were able to take them; while eggs, jelly, and other extracts were ordered as required in individual cases. The stimulant employed was rum, given in quantities varying from three to eight ounces daily, according to the indications in each case. The medicinal treatment was largely symptomatic. The mixture most frequently given contained quinine, hydrobromic acid, spirits of nitrous ether, nitrate of potash, and liquor strychniæ. If the skin was excessively dry and hot, a diaphoretic mixture, containing liquor ammoniæ acetatis, nitrate of potash, and spirits of nitrous ether, was preferred to the above. A purgative (castor oil or calomel) was in many cases administered immediately after admission. An excessively high temperature (105° or more) was in many instances reduced with ease and safety by the exhibition of phenacetin, in a dose of 10 or 15 grains, given in hot rum and water to counteract the depressing effect, and followed by a dose of spirits of nitrous ether. The hot pack was occasionally used to still further promote perspiration. A failing pulse and general weakness were combatted by the hypodermic injection of strychnia and sulphuric ether, repeated twice or thrice daily or every four hours according to the condition of the patient. Native plague patients were found to be remarkably tolerant of strychnia, and 5 minims of liquor strychnia could be injected hypodermically every four hours, and the same quantity administered internally without risk of producing symptoms of poisoning and with undoubted benefit to the general condition. Delirium and sleeplessness were controlled by bromides, morphia or sulfonal. Other symptoms, such as vomiting, hiccough, constipation or diarrhœa, and complications such as pneumonia, were all treated by the remedies appropriate for them. Bubóes were as a rule poulticed. If suppuration occurred, the bubo was incised and treated on general surgical principles; if the patient convalesced without suppuration occurring, the bubo was painted with tr. iodi. Furuncles were opened if necessary. Ulcerations and necrosed patches of skin were treated on general principles.

Case I.—*Register No. 812.*—Gunput Khundoo, male, Hindu, *ætat* 21; admitted 6th March 1898, at noon, with a history of three days' illness.

State on admission.—Temperature 102°; pulse weak; respiration 32. The tongue is coated with fur on the dorsum, but clean at the tip and edges. skin is dry and the conjunctivæ are injected. The some headache. There is no cough. There is a bubo i right groin.

Course of the illness.—On the afternoon of 6th M he was very restless, delirious, and at times violent. 7th March the temperature was 99·8° at 6 A.M. and at but rose to 101·8° at 6 P.M. and 103° at midnight. pulse was 124 at 6 A.M. and 152 at 6 P.M.

On the morning of 8th March the condition w follows:—The conjunctivæ are deeply injected and th glued together with pus; there are signs of comme keratitis. The tongue is coated on the dorsum with a yellowish grey fur; it is pink and moist at the The pulse is 144, irregular, compressible and weak. respiration is 20, regular, and not shallow. The pati drowsy, but at the same time restless, and tosses about frequently throwing his arms about and turning fror to side. He is able to understand and answer ques but the speech is indistinct and slow, and he tend stantly to relapse into silence and drowsiness. There is tender bubo, the size of a walnut in the right groin; are no others elsewhere. The urine is acid, and co albumen. The temperature at noon was 98·4. At 3 an injection of 20 c.c. of the "curative" serum w ministered in the flank. At 7 P.M. the temperatur 103·4°, pulse 156, very weak and compressible, respi 30, regular. The general condition was unchanged midnight the temperature was 102·6.

March 9th.—The patient slept well all night. keratitis is increasing; 20 c.c. of serum were again in at 3 P.M. The temperature, pulse, and respiration r are shown in the attached chart.

March 10th.—The pulse is much better, less rapi stronger. The tongue is cleaning, the grey, dried and fur coming off in flakes. The keratitis is increasing ir eyes. This has been treated from the beginning atropia drops, frequently instilled, irrigation with b acid lotion, and the application of a pressure bandage; of serum were again injected.

March 11th.—There is nausea and some hiccough, is controlled by hypodermic injections of morphia and pisms over the epigastrium. There is occasional deli 20 c. c. of serum were again injected.

March 12th.—The patient slept very badly. Th intense conjunctival injection and complete corneal o in both eyes. The tongue is much cleaner, but quit The bubo has immensely increased in size, and now me 5 by 3 inches. It is hard and tender. Twenty c. c. of were again injected.

March 13th.—He was delirious and noisy in the but slept at intervals. Albumen is still present in the As the temperature had fallen to nearly normal, no inj of serum was given.

March 14th.—He was restless in the night, bu after a dose of morphia. The pulse is fair. The large central ulcer in the left cornea. Vomiting i troublesome; it is not controlled by treatment (cocai etc.). The temperature is normal or subnormal.

March 15th.—The general condition is unaltered. miting is still severe.

March 16th.—A diffuse glandular swelling has ap behind and below the right ear. The vomiting is s less severe, but still troublesome. There is constant de and the patient is very restless.

March 18th.—The general condition is unaltered. The bubo in the groin remains unchanged: that in the neck is larger. It is hard and tender. Neither shows any signs of suppurating. The patient is very weak, delirious, and restless. There is a condition of pan ophthalmitis in both eyes. The gums have become soft and spongy, and there is a constant oozing of blood from them; the condition closely resembles that seen in scurvy. The patient died at 10-5 P.M. The temperature had been subnormal (96°) since noon.

This patient received in all 100 c.c. of the serum in five doses. Death occurred on the 16th day of the disease and the 11th day after commencement of the serum-treatment.

CASE II.—*Register No. 816.*—Sadanund Mukund, male, Hindu, *ætat* 22, mill-hand, admitted 7th March at 1 P.M.

History.—Pain in the right groin was first observed on the previous evening (March 6th), there was no rigor; severe headache, unaccompanied by giddiness, developed on the morning of admission.

State on admission.—The temperature is 104·8°; the pulse is fairly good, 86 per minute; respiration 42, regular, but shallow. The tongue is thickly coated with white fur on the dorsum, leaving the edges pink and clean. The conjunctivæ are markedly injected. The mental state is clear, but the speech is slightly hesitating. Loud snoring rhonchi are heard over both lungs: they are more pronounced on the left side. There is much muco-purulent sputum. The urine is free from albumen. In the right groin is a very tender bubo, the size of a large walnut.

Course of the illness.—From 8th March to 15th March both dates inclusive, this patient received a daily injection of 20 c. c. of the serum. On the 8th the highest temperature recorded (at 6 P.M.) was 104·6°; on the 9th it rose to 105°, and there was noisy delirium in the earlier half of the night, requiring sulfonal to control it. On the 10th the highest temperature was 103·8°; the pulse was still fairly good; the urine was still free from albumen. On the 11th the temperature rose to 104·6°; the fur on the tongue had become dry and brown in the centre, leaving a white line on either side and pink edges. On the 13th there was again some delirium; the pulse was good, and the patient slept at intervals; the respiration was rapid, and there were constant rhonchi in both lungs. On the 14th the tongue was beginning to clean. On the 16th the temperature fell to normal. On the 17th fluctuation was detected in the bubo; an incision was made, and pus evacuated. On the 21st the chest was almost clear, only very occasional rhonchi being heard. On the 22nd the pulse intermitted every sixth or seventh beat; on the 23rd the pulse was good, and not intermittent. (From 25th March to 5th April I was absent from Parel, and no notes were taken in the interval.) On 10th April the incision wound in the groin was very nearly healed; the temperature had been normal since 16th March, and the general condition was excellent. The patient was discharged quite cured on 2nd May. He had received in all 160 c.c. of the serum.

CASE III.—*Register No. 818.*—L. X. DaSouza, Christian, male, *ætat* 21, an engine-driver; admitted 8th March, at 9-15 A.M.

History.—The attack commenced at midnight, with fever and pain and swelling in the left groin; there has been slight headache, but no giddiness; the bowels have been moved once; the motion was loose. There has been no cough.

State on admission.—The temperature is 100°; pulse fairly full, but soft and compressible, 112 per minute. The patient is quite conscious; the speech is clear, and not affected in any way. The tongue is slightly coated with white fur, moist, slightly tremulous, pink and clean at the edges. There is a bubo in the left femoral region, just below Poupart's ligament; it is of the size of a large walnut; is only slightly tender, and shows no signs of softening. The patient is tall and of remarkable muscular strength and development.

Course of the illness.—At 3 P.M. on the 8th (that is to say, fifteen hours after the onset) he received an injection of 20 c. c. of the serum. At 7 P.M. the temperature was 103°; pulse 128, full and regular; respiration 34, regular; the bowels had been opened once. On 9th March the temperature varied between 100·8° and 102°; a second injection of 20 c.c. of the serum was given. On the 10th the tongue was still coated with white fur with pink papill showing through; the pulse was fairly strong; he slept at night; there was no delirium or other mental symptom, and the general condition was excellent. In the afternoon a change for the worse set in, and at 6 P.M. hiccough commenced, and became troublesome. This was kept in check by the sucking of ice, the application of sinapisms, and the exhibition of morphia, bromides, and tincture of capsicum. At midnight the temperature was 103°, pulse 100, and respiration 36; there was slight delirium, and the general condition was distinctly worse. During the night he slept but little. At 6 A.M. on 11th March he was still delirious; the pulse was becoming weak; the hiccough, which had been checked, returned. There was a rapid increase in the general weakness; the pulse became very small, and the patient sank and died at 9-15 A.M., 81 hours after the onset and 66 hours after commencing the serum treatment. The case was a most disappointing one; but is an instructive illustration of the fact that no case of plague, however apparently mild and in however healthy a subject, can be regarded as free from danger. The patient received in all 40 c.c. of the serum.

CASE IV.—*Register No. 822.*—Mukti Bhaoo, Hindu, female, *ætat 65*; admitted 8th March, at 9 P.M., with a history of one day's illness.

State on admission.—Temperature 102·8°; pulse 88, very weak; respiration 26. The patient is unconscious. The tongue is dry and coated with white fur. The conjunctivæ are deeply injected, and there is a purulent discharge from the lids. There is no bubo.

Course of the illness.—She was ordered a diaphoretic mixture with digitalis, and later, citrate of caffeine and bromide of potassium. On 9th March the highest temperature was 104°. The patient had slept at intervals, and had recovered consciousness. The pulse was fairly good; an injection of 20 c.c. of serum was given at 3-25 P M. On the 10th an enlarged and painful glandular swelling appeared in the left femoral region. The pulse was very small. She had slept fairly well. A second injection of 20 c.c. of the serum was given at 4 P.M. The patient sank, and died at 2 A.M. on the 11th, on the fourth day of the illness and 34½ hours after commencing the treatment. She had received in all 40 c.c. of the serum.

CASE V.—*Register No. 825.*—Jaky Britto, Christian, male, *ætat* 30, tailor; admitted 9th March, at 10-10 A.M., with a history of five days' illness.

State on admission.—The patient is conscious. There is light delirium. The temperature is 102·6°, pulse 110 and fairly strong; respiration 30. The tongue is thickly coated with white fur, with "mother-of-pearl" appearance. The speech is slow, "difficult," and not unlike that of a drunken man. In the right groin is a bubo, of the size of a walnut, very tender, and hard. On the abdomen is a large cauterized surface, about 6 inches square, over which the epidermis has been completely destroyed by the application of some caustic, and there is a similar, but much smaller patch on one arm.

Course of the illness.—At 2 P.M. on the day of admission 20 c.c. of the serum were injected, and this was repeated on each of the two following days. At night the patient was very noisy and delirious, requiring sulfonal, and later morphia. On the 10th the lips were dry and cracked, the teeth were coated with sordes. He was querulous and complaining, but frequently lapsed into drowsiness. The pulse was weak. There had been no motion. He was ordered one ounce of castor-oil and hypodermic injections of strychnia and ether, repeated every four hours, in addition to the ordinary treatment. At night he was again troublesome and noisy. On the 11th he was still weaker, the highest temperature (at 5-30 P.M.) was 104·2 At night he was again noisily delirious, and the pulse was very weak. He sank and died at 7-40 A.M. on the morning of the 12th, on the eighth day of the illness and on the third day after commencing the serum treatment. He received in all 60 c. c. of the serum.

CASE VI.—*Register No 827.*—Jairam, Hindu, male, *ætat* 25, admitted 9th March, at 11 A.M.; duration of illnes unknown.

State on admission.—Temperature 103·4; pulse 128, respiration 44. The patient is almost unconscious, but can be roused and induced to answer some questions. The tongue is lightly coated; the conjunctivæ are deeply injected. The pulse is weak and dicrotic. The spleen is enlarged and distinctly palpable below the ribs. Constant rhonchi are heard over both lungs, and there is some muco-purulent sputum. There is a small tender bubo in the right axilla. Both motions and urine are passed involuntarily.

Course of the illness.—At 2 P.M. 20 c. c. of the serum were injected in the flank, and this was repeated on each of the two following days. On the 10th the mental state was unaltered ; the pulse was rapid and weak ; the temperature varied between 102° and 102·6°. On the 11th he was still semi-conscious ; he took his food well. At 11 A.M. the pulse became weaker, and the respiration rose to 58 per minute. He was ordered hypodermic injections of strychnia and ether. At 5-45 P.M. the temperature rose to 105°, and he died at 5-45 P.M., 55 hours after admission and 52 hours after the commencement of the serum treatment. The total amount of serum injected was 60 c. c.

Case VII.—*Register No. 832.* - Miguel X. Fernandez, Christian, male, *ætat* 32, a cook, admitted 10th March, at 9-20 A.M.

History.—He has complained of pain in the back for two days. Rigors occurred at 3 A.M. this morning, and are still continuing. A bubo appeared in the right groin last night.

State on admission.—The tongue is lightly coated, moist, with pink edges and pink papillæ showing through the fur. The conjunctivæ are lightly injected. There is slight drowsiness. The speech is clear, but slow. There is some cough, but the chest is clear. The spleen is not enlarged. There is a small, tender, right inguinal bubo. The pulse is 126 and fairly strong. There is headache and giddiness.

Course of the illness.—At 3 P.M. on 10th March 20 c.c. of serum were injected. On the 11th the tongue was drier and brown in the centre; the bubo was unaltered; there had been delirium during the earlier part of the night. Twenty c.c. of serum were again injected, and this was repeated on the 12th. At 6 P.M. on the 12th the temperature was 105°. At 10 P.M. an additional injection of 10 c.c. of the serum was administered; at midnight the temperature was 102·6°. He slept fairly well. On the 13th slight ptosis developed on the left side. The patient was drowsy and semi-conscious; the pulse was fairly good. The temperature at 6 P.M. was 103°; the pulse was then very weak. One injection of 20 c.c. of serum was administered. On the 14th at 9 A.M. the patient was perspiring profusely; the pulse was very weak; the tongue was dry, glazed, and brown. There was slight spasm of the left facial muscles. The patient sank, in spite of the free exhibition of stimulants, and died at 7-15 P.M., on the seventh day after the onset and 100 hours after the commencement of the serum treatment. He received in all 90 c.c. of serum.

Case VIII.—*Register No. 836.*—Pedro DaSouza, Christian, male, *ætat* 19; admitted 11th March 1898, at 8 P.M., with a history of one day's illness.

State on admission.—Temperature 105·8°; pulse 138; respiration 44. The conjunctivæ are lightly injected. The tongue is thickly coated with white fur, but moist and pink at the edges. The skin is hot and dry. The patient is unconscious. The spleen is not enlarged: the lungs are normal. There is a small, hard, tender bubo in the right femoral region.

Course of the illness.—On 12th March the condition was unchanged. Thirty c.c. of serum were injected at noon and 20 c.c. at 10 P.M. The temperature at noon was 105·4°; at 6 P.M. 102°, and at midnight 100·4°. He slept well, and on the morning of the 13th at 6 A.M. the temperature had fallen to 99·5. Consciousness returned, and the pulse was stronger. Thirty c.c. of serum were again injected at noon and 20 c.c. at night. The highest temperature this day was 103·6.

On the 14th the bubo was much larger, of the size of an orange and becoming softer. The tongue was cleaning and the pulse stronger. On this and the following day two injections of the serum, of 30 c.c. and 20 c.c respectively, were administered. On the 16th temperature was 101°; the general condition was greatly improved. A furuncle appeared on the dorsum of the right foot. 30 c.c of serum were injected on the 16th; 20 c c. on the 17th, and 40 c.c. on the 18th. The temperature on the 18th only rose to 99°. On the 19th a scattered urticarial rash appeared over the thorax, the wheals were large and discrete. The tongue was cleaning from the edges. The urticaria disappeared on the 20th. On the 21st the bubo was incised, and about one drachm of pus evacuated. On the 24th the tongue was almost clean; the pulse was good, and the temperature almost normal. The patient was discharged cured on 27th April. He received in all 290 c.c. of serum.

Case IX.—*Register No. 838.*—Laku Govind, Hindu, female, *ætat* 12; admitted 12th March, at 1 A.M., with a history of five days' illness, characterised by rigors, cough, and fever and by diarrhœa for the two days previous to admission.

State on admission.—Temperature 100°; skin hot and dry. Conjunctivæ lightly injected. Tongue thickly furred. Pulse small and soft. Lungs normal. There is a right inguinal bubo.

Course of the illness.—During the morning the patient appears to have fallen out of bed. A large haematoma developed on the forehead, and severe convulsions set in. At 3 P.M. an injection of 20 c.c. of the serum was administered. notwithstanding the patient's serious conditions. At 3·30 P.M. the following note was made:—The patient is convulsed and unconscious; the pupils are widely dilated and inactive. There are frequent tonic spasms of the whole body going on to opisthotonos; the legs are widely extended, the arms are flexed and hands clenched, and there is grinding of the teeth. The rigidity lasts about two minutes, and is succeeded by clonic spasms of the whole body. The urine is passed involuntarily. The temperature is 105°. Death occurred five minutes later, on the sixth day of the disease and 35 minutes after the first and only injection of 20 c.c. of the rum.

Case X.—*Register No. 840.*—Ram Charan Sripat, Hindu, male, *ætat* 22, carpenter; admitted 12th March, at 8-30 A.M.

History.—The initial rigor occurred on the previous morning, and a swelling in the left groin appeared in the afternoon.

State on admission.—The tongue is covered with a thin greyish coating of fur, which is glazed and dry in patches. The conjunctivæ are injected. The pulse is fairly strong. The patient is drowsy and "drunken" looking. The speech is "thick," slow and hesitating. The spleen is not enlarged. The lungs are normal. There is a small bubo in the left groin.

Course of illness.—At 2 P.M. on the day of admission 30 c.c. of the serum were injected, and at 10 P.M. a second dose of 20 c.c. The highest temperature (at 6. P.M.) was 104°. On the 13th, at 6 A.M., it was noted that he had slept well; that the tongue was cleaner and less glazed, and that the pulse was fair. At 8 A.M., however, the pulse became very weak and the general condition became worse. He received another injection of 30 c.c. of serum at 2 P.M. In spite of stimulant treatment, the patient sank and died at 10-30 P.M., on the third day of the disease and 32¼ hours after commencing the serum treatment. He received in all 80 c.c. of the serum.

Case XI.—*Register No. 843.*—Govind Buster Hindu, male, *ætat* 9, admitted 13th March, at 10-40 A.M., with a history of nearly 16 hours' illness (*i.e.*, since 7 P.M. of the previous day).

State on admission.—Temperature 100·6°; pulse 128, weak; respiration 40. The tongue is coated with white fur on the dorsum, leaving the edges pink and moist. The conjunctivæ are deeply injected. This patient is semi-conscious; he had been delirious in the night. The chest is normal and there is no cough. The spleen is not enlarged, and the urine is free from albumen. There is a large, diffuse bubo in the left axilla.

Course of the illness.—At 2 P.M. on the day of admission 20 c.c. of the serum were injected and a second injection of 10 c.c. was administered in the evening. On the following day (March 14th) there was no improvement. 20 c.c. of the serum were injected at 2 P.M. The patient sank and died at 3-50 P.M., 45 hours after the onset and 26 hours after the commencement of the serum treatment. He received in all 50 c c. of the serum.

Case XII.—*Register No. 847.*—Kana Mowji, Hindu male, *ætat* 25, mill-hand; admitted 13th March, at 2·3 P.M.

History.—There was a sudden rigor on the previous morning, severe headache set in, and in the evening buboes appeared in the right groin and on the right side of the neck.

State on admission.—The patient is semi-conscious, but delirious and violent at times. The tongue shows the characteristic white fur on the dorsum with pink and moist edges. The conjunctivæ are injected. The pulse is 150, very weak and compressible. The lungs are normal. The spleen is greatly enlarged and easily palpable below the ribs. There is a large diffuse, right cervical bubo, and a second smaller bubo in the right groin.

Course of the illness.—At 4 P.M. on the day of admission 30 c.c. of the serum were injected. The temperature on admission (at 2-30 P.M.) had been 104°; at 6 P.M., two hours after the injection, it had fallen to 101·2°. On 14th March, at 6 A.M., the temperature was 100°; the pulse 150; the general condition was the same, and there was marked *risus sardonicus*. At 7 A.M. an injection of 20 c.c. of serum was given and a second one of 30 c.c. at 11 A.M. The patient was delirious throughout the day. On 15th March the pulse was very weak; the patient was semi-conscious and delirious; the extremities became cold, and the pulse later in the day became imperceptible. In spite of symptomatic treatment death occurred at 6 P.M., on the fourth day of the disease, and 50 hours after commencing the serum treatment. The total amount of serum injected was 80 c.c.

CASE XIII.—*Register No. 850.*—Anton DaSouza, Christian, male, *ætat* 23, compositor in the printing office, admitted 13th March, at 10-30 P.M., with a history of eleven hours' illness.

State on admission.—Temperature 105·2°. The tongue is coated with white fur, especially thick at the back. The speech is "thick" and slow. The spleen is not enlarged. The chest is normal; there is slight cough. The bowels are confined. There is a small tender bubo in the left axilla.

Course of illness.—On the morning of the 14th at 6 A.M. the temperature had fallen to 100·6. At noon the temperature again rose to 104·4. An injection of 30 c. c. of the serum was administered, and a second one of 20 c.c. at 11 P.M. The temperature fell at 6 P.M. to 102° and at midnight to 100°. On the 15th there was vomiting at intervals; it was checked by a bismuth mixture and a sinapism externally. 20 c.c. of serum were again injected. On the 16th, 17th, and 18th a daily injection of 30 c. c. was given. The vomiting ceased on the 16th, and the tongue was cleaner on the 17th. On the 19th a bubo appeared in the left groin. On this and the three following days 40 c.c. of serum were injected daily. On the 20th the tongue was dry, caked, and cracked, and dry sordes had collected round the teeth. On the 21st the pulse was weak; the chest was normal; the urine was free from albumen. On the 22nd the pulse was very rapid (164) and weak; there was marked emaciation; the face was excessively pale, and there was a blue-black discoloration around the eyes. The chest was normal in front, but there were profuse moist sounds all over both lungs posteriorly; the urine was still free from albumen. On the 23rd the tongue was very dry, caked, and brown, and the general condition was "typhoid." The pulse was slightly better. Twenty c. c. of serum were injected. On the 24th there was extreme weakness; at 9 A.M. the respiration was 64 and very shallow; the pulse was almost imperceptible. The tongue was cleaning; the fur peeling off in thick dry flakes. The patient was semi-conscious. The buboes were unaltered. The urine was still free from albumen. Death occurred at 10·50 A.M. on the 11th day of the illness and the 10th day of the treatment. The total amount of serum injected was 340 c.c.

CASE XIV.—*Register No. 814.*—Rewa Kalichurn, Hindu, female, *ætat* 19, mill-hand; admitted 14th March at 3-35 P.M.

History.—Rigors occurred on the previous evening; there has been headache; no vomiting; the bowels are confined.

State on admission.—Temperature 105°; pulse 120, fairly good; respiration 35. The tongue is thickly furred. There is extreme drowsiness. The lungs are normal. There is a tender bubo in the left groin.

Course of the illness.—At 4 P.M. on the day of admission 30 c.c. of serum were injected. On 15th March three injections of 20 c.c. each were administered—one at 7 A.M., one at 2 P.M., and one at 10 P.M. She slept well, but was at times delirious and violent: the pulse was better, and the highest temperature was 101·8°. On the 16th there was a further improvement. She was quite conscious; the tongue was cleaning; the pulse still stronger, and the bubo less tender. One injection of 20 c.c. of serum was given, and this was repeated on the two following days. On the 17th she was less apathetic; the tongue was cleaning at the tip and sides; the pulse was 136 and small. On the 18th the pulse had improved; the glandular swelling in the groin had spread to and involved the femoral glands. She slept and took her food well. On the 19th it was noted that she had been delirious in the early part of the night; the respiration was rapid and shallow. On the 20th temperature rose to 103° and the respiration to 55; there was dulness at the right base posteriorly an dloud bronchial breathing below a line one inch below the angle of the scapula, accompanied by sharp crepitations. There had been delirium during the night, but throughout the day the patient was quiet, but "wandering." Death occurred at 3-5 P.M. on the seventh day of the illness and six days after commencing the treatment. The total amount of serum injected was 150 c.c.

CASE XV.—*Register No. 856.*—Bhagrithi Yesso, Hindu, female, *ætat* 35, mill-hand; admitted 14th March, at 4·35 P.M.

History.—The onset, with rigor and headache, occurred four days previously; there had been no vomiting; the bowels were opened; the bubo appeared the day after the onset.

State on admission.—The temperature is 102·8°; pulse 120, fairly good; respiration 38. The tongue is thickly furred. The lungs are normal. The patient was confined four months ago, and the breasts are full of milk. There is a bubo in the left groin; the skin over it is deeply ulcerated (probably by some native application), and the fascia above Poupart's ligament is laid bare.

Course of the illness.—Half-an-hour after admission 30 c.c. of the serum were injected. On the following day (15th March) the temperature at 6 A.M. was 100°; 20 c.c. of serum were injected at 7 A.M. and 10 c.c. at 10 P.M. The patient slept and took her food well. On the 16th the temperature at 6 A.M. was 105°; there was mild delirium and the speech was very indistinct. The respiration was 54, and a patch of dulness with bronchial respiration and bronchophony developed below the angle of the left scapula. Death occurred at 1-30 P.M., on the sixth day of the disease and 44½ hours after commencing the treatment. The total amount of serum injected was 60 c.c.

CASE XVI.—Appo Abdul Kadir, Muhammadan, female, *ætat* 12; admitted 15th March, at 9-30 A.M., with a history of illness, commencing with rigor on the previous evening.

State on admission.—Temperature 104·2°; pulse 132 and very small. There is extreme drowsiness. In the right groin is a tender bubo. 30 c.c. of serum were injected. At 2 P.M. there were slight convulsive movements of both hands; the thumbs were bent in upon the palms and the fingers extended. The pupils were contracted. Death occurred at 1 A.M. on the 16th, on the second day of the disease, and in less than 15 hours after the first and only, injection of 30 c.c. of the serum.

CASE XVII.—*Register No. 865.*—Mukti Vithoo, Hindu, female, *ætat* 20; admitted 15th March, at 10-20 A.M., with a history of seven days' illness, characterised by fever and pain and swelling above the left shoulder.

State on admission.—Temperature 100·4°, pulse 156, very small and soft, but regular. Conjunctivæ lightly suffused. Tongue thickly coated. There is a painful bubo in the left posterior triangle of the neck: the skin is ulcerated over it.

Course of the illness.—At 1-30 P.M. on the day of admission 30 c.c. of the serum were injected, and a second injection of 20 c.c. was given at 10 P.M. On the following day, March 16th, the temperature did not rise above 100°. The patient was restless in the night, and during the day there was low muttering delirium. The pulse was small and soft. 30 c.c. of serum were again injected. On the 17th the temperature varied between 99° and 100°; the delirium continued. 30 c.c. of serum were injected. On the 18th the patient was restless and noisily delirious; she was nearly, but not quite, unconscious. The respiration was very rapid and irregular, and the pulse almost imperceptible. Death occurred at 2-25 P.M. on the 10th day of the disease and rather more than three days (73 hours) after the first injection of serum. The total amount of serum injected was 110 c.c.

CASE XVIII.—*Register No. 868.*—Chambai Vaduraj, Hindu, female, *ætat* 30; admitted 15th March, at 11 A.M.

History.—Fifteen days previously dead rats had been found in the house, and about that time she observed a swelling on the right side of the neck, but the onset of fever occurred only four days before admission.

State on admission.—The patient is quite conscious. There is slight headache and giddiness. The tongue is furred. There is some cough and pain in the chest; coarse sibilant rhonchi are heard all over both lungs; the percussion note is resonant everywhere; respiration is 60 per minute. The pulse is fairly good. The right parotid gland is swollen and tender.

Course of the illness.—At 4 P.M. on the day of admission 30 c.c. of serum were injected, and this was repeated at 2 P.M. on the following day (16th March). She was restless during the night; on the 16th the tongue was very thickly furred; the bubo showed signs of softening. Death occurred at 4 P.M. on the 16th, five days after the onset of fever and 31 hours after commencing the serum treatment. The total amount of serum injected was 60 c.c.

CASE XIX.—*Register No. 877.*—Kassi Succaram, Hindu, female, *ætat* 9; admitted 16th March, at 7-20 A.M.

History.—The illness began on the previous day with fever, pain in the right groin, and vomiting.

State on admission.—Temperature 102·4°; pulse 104, very small. The tongue is thickly furred. Rhonchi are heard over both lungs. There is a right femoral bubo.

Course of the illness.—At 4-30 P.M. on the day of admission 20 c.c. of serum were injected, and the same amount was injected on each of the two following days. The highest temperature on either of these days was 103°. On the 19th the temperature fell to normal and did not again rise. The bubo suppurated and was opened on 26th March, when one ounce of pus was evacuated. Convalescence was uneventful, and the patient was discharged cured on 12th April. The total amount of serum injected was 60 c. c.

CASE XX.—*Register No. 890.*—Deo Francis, Christian, male, *ætat* 40, painter; admitted 16th March, at 9-30 A.M., with a history of illness since the previous morning.

State on admission.—The tongue is thickly coated, dry and brown in the centre, with a white zone on either side and pink and moist edges. The conjunctivæ are injected. The pulse is fairly good. The spleen is not enlarged. The lungs are normal. The patient is conscious, but the speech is "thick" and slow. There is a small, "nutty," not very tender bubo in the left groin.

Course of the illness.—At 2 P.M. on the day of admission 30 c. c. of the serum were injected; and the second injection of 20 c.c. was given at 11 P.M. On the 17th March, the condition was worse; the pulse was weaker. 40 c.c. of serum were injected at 3 P.M. During the night he became very weak; he refused food and had to be fed *per rectum*; the respiration became very rapid and the pulse imperceptible. Death occurred on the 18th at 10-35 A.M., three days after the onset and 44½ hours after commencing the serum treatment. The total amount of serum injected was 90 c.c.

CASE XXI.—*Register No. 885.*—Kondee Rama, Hindu, male, *ætat* 18, grain-vendor; admitted 16th March, at 12-30 (noon).

History.—The onset occurred on the previous evening with rigors and bilious vomiting, severe headache and giddiness, and pain and swelling in the left groin.

State on admission.—Temperature 103·2°; pulse 116; respiration 40. There is a tender bubo in the left femoral region. The bowels are confined.

Course of the illness.—An injection of 30 c.c. of the serum was given at 3 P.M. on 16th March. The temperature at 6 P.M. was 104·4°. The patient became gradually worse, and died at 4-50 A.M. on the morning on the 17th, on the second day of the disease and 13½ hours after the first and only injection of 30 c.c. of the serum.

CASE XXII.—*Register No 888.*—P. N. Fernandez, Christian, male, *ætat* 45, tailor; admitted 16th March, at 4 P.M., with a history of four days' illness.

State on admission.—The tongue is lightly coated with yellow fur and moist. The patient is conscious; the speech is not quite clear. The pulse is fairly good. The spleen is not enlarged. There is a large, hard, diffuse bubo in the left inguinal region, measuring five inches by three.

Course of the illness.—On the day of admission 30 c.c. of serum were injected in the afternoon and 20 c.c. at 10 P.M. On 17th March, 30 c.c. were injected. On the 18th, the bubo showed signs of superficial softening. On this and the following day an injection of 40 c.c. of serum was given. On the 19th an incision was made, and a small quantity of pus was evacuated. On the 21st the tongue was markedly cleaner and the pulse stronger. The bubo was still large, diffuse, and hard; the pus evacuated on the 18th had been quite a superficial collection, and the greater part of the glandular tumour had not suppurated; nor did it do so subsequently. On the 24th it was noted that he slept well, and that the bubo was unaltered. (From 24th March to 5th April I was absent.) On 5th April he was convalescent, but suffering from sleeplessness. The bubo was diminishing. Its absorption was slow, and there was still some fulness in the groin when he was discharged on 4th May. He had received in all 160 c.c. of the serum.

CASE XXIII.—*Register No. 892.*—Visharanath Sadashri, *ætat* 20, Hindu, male, Custom House clerk; admitted 16th March, at 6-15 P.M.

History.—The patient has previously had repeated attacks of malarial fever. The present illness began this morning, with rigors, fever and pain in the left groin.

State on admission.—Temperature 104·4°; pulse good. The tongue is loaded with a greyish white fur on the dorsum, and is moist and clean at the edges. The conjunctivæ are injected. The spleen is not enlarged. The lungs are normal. There is a left inguinal bubo, small and tender.

Course of the illness.—On 17th March and on each succeeding day up to and including the 20th an injection of 40 c.c. of the serum was administered. The highest temperature on the 17th was 102·4. On the 18th the temperature was 98° at noon and 103·8° at 6 P.M.; the tongue was cleaner and the pulse still good. On the 19th the lowest and highest temperatures were respectively 100° and 104°. On the 20th the tongue was nearly clean, but the pulse was weaker; the patient slept badly, and the urine contained a light cloud of albumen. The temperature varied between 103° and 104°. On the 21st the temperature fell to 97·6°; the bubo was larger and tender, and the pulse was still weak. The pulse was better on the 22nd, and the temperature remained normal until midnight, when it rose suddenly to 104·2°. Nothing could be discovered in the lungs or elsewhere to account for this rise. After a dose of phenacetin, with hot rum and water and followed by a dose of spirits of nitrous ether, the temperature fell to 99·6°. On the 23rd the highest temperature was 103·8 at noon. On the 24th the pulse was still weak, and the urine contained a rather larger quantity of albumen; he slept well at night under small doses of morphia. No injection of serum had been given on the 21st, as the temperature had fallen to normal, but the injections were resumed on the 22nd, and a daily injection of 40 c.c. was given up to and including the 24th, and one of 20 c.c. on the 25th; no injection was given on the 26th and one of 40 c.c. was administered on the 27th. (From 25th March to 4th April I was absent from the hospital.) On the 25th March the cloud of albumen in the urine was diminished, and on the 26th the urine was free from albumen, and remained so from that date. The temperature on the 26th varied between 98·4° and 100°, and on the 27th between 97° and 103°; it was normal on the 28th, and the patient was removed to a convalescent ward. On 1st April the temperature varied between 99° and 100°; fluctuation was detected in the bubo; an incision was made and pus evacuated. A second bubo had appeared in the right groin. This on 4th April was found to be small, and not tender; it was said to have been larger and tender when first noticed (the exact date of its appearance was uncertain; it was probably about 1st April). The temperature remained normal, and convalescence was uninterrupted until 10th April when the temperature rose to 103·2° without apparent reason. On the 11th there was some cough; on examining the lungs the percussion note was normal; breathing was vesicular in all parts; occasional rhonchi were heard on both sides posteriorly. The temperature varied between 101·2° and 101·8°. On the 12th it fell to 100° and on the following day to normal; the tongue was then clean and the general condition improving. The return to recovery was not again interrupted, and on 3rd May (when I left Parel) the patient was nearly ready for discharge; some thickening still remained in both groins. The total amount of serum injected in this case was 340 c.c. The patient was a malarial subject, and this probably explained the repeated rises of temperature; the accesses of fever were not influenced in any way by the injections of serum.

CASE XXIV.—*Register No. 898.*—Manual Kini, Christian, male, *ætat* 25, labourer; admitted 17th March, at 11-20 A.M., with a history of two days' illness.

State on admission.—Temperature 102·2°; pulse very weak, 116; respiration 30. Tongue coated with the characteristic white fur, leaving the edges pink and moist. The patient is conscious, but the mental state is clouded and the speech slow and "thick." There is a small, tender bubo in the right femoral region.

Course of the illness.—At 3 P.M. on the day of admission, 40 c.c. of serum were injected. On the 18th there was no change in the condition: 40 c.c. of serum were again injected at 3 P.M. The temperature rose at 6 P.M. to 104·8°. Death occurred at 11-5 P.M., on the fourth day of the disease and 32 hours after commencing the serum treatment. The total amount of serum injected was 80 c.c.

CASE XXV.—*Register No. 901.*—Tukaram Balu, Hindu, male, *ætat* 14, mill-hand; admitted 18th March, at 10-10 A.M., with a history of eight days' illness.

State on admission.—The tongue is slightly furred, with red papillæ showing through the fur; the edges are clean. The conjunctivæ are lightly injected. There is cough, and loud rhonchi and râles are heard over both lungs posteriorly; these are most marked at the right base; the percussion note is not impaired in any part. The urine is acid and free from albumen. There is a large, tender, diffuse bubo in the right femoral region, measuring 4 inches in each diameter. There are three ulcerated and necrosed patches on the inner surface of the right thigh, and one large furuncle and one small one on the right shin.

Course of the illness.—On 18th March 40 c.c. of serum were injected in the afternoon and 20 c c. at night; and on the 19th one injection of 40 c.c. was given. On the 20th the urine showed the dark green discoloration characteristic of the absorption of carbolic acid. (The serum contains 0·5 per cent. of carbolic acid in order to preserve it.) The urine was free from albumen. On this date the bubo was opened, and half an ounce of pus was evacuated; the two furuncles on the right shin were incised, and a small quantity of pus escaped from each. 40 c.c. of serum were injected at noon (the discoloured urine had been passed just before). On 21st March no injection was given; the pulse was good and the tongue clean. On the 22nd sibilant rhonchi were heard over the left lung posteriorly and medium crepitations at the right base posteriorly; there was still no dullness on percussion and no cough. 40 c.c. of serum were injected, but the urine did not become discoloured. On the 23rd there was dulness with bronchial breathing over the right base posteriorly. The tongue was cleaner. No injection was given on this or the following day. On the 24th the tongue was clean and the pulse good; the skin had necrosed over the bubo, and a large, sloughy, ulcerated patch had formed which was discharging freely; the other ulcerated patches showed little change. (From 25th March to 4th April I was absent.) On 25th March another injection of 20 c.c. of serum was given, and the urine again became discoloured. The injections were in consequence stopped. On my return on 4th April the patient's general condition was satisfactory; the lungs were clear; the ulcerated patches were commencing to heal, the temperature had not risen above normal after 25th March. The temperature had at no time risen above 103°. There was a slight attack of diarrhœa on 7th April, but recovery was otherwise uninterrupted. The ulcers were slow in healing, and were still not quite healed on 3rd May (when I left Parel). This patient received in all 200 c.c. of serum.

CASE XXVI.—*Register No. 904.*—Rama Vithu, Hindu, male, *ætat* 30, mill-hand; admitted 18th March, at 11·50 A.M., with a history of four days' illness.

State on admission.—The tongue is characteristic. The conjunctivæ are suffused. The pulse is fairly good. The spleen is not enlarged. There is no headache. The speech is clear. The patient is delirious at times. The urine is acid, and gives a light cloud of albumen on boiling. There is a small bubo in the left groin.

Course of the illness.—From 18th March to the 22nd a daily injection of 40 c.c. of the serum was administered; on the 23rd one of 20 c.c. was given; none were given subsequently. On the night of the 18th there was much delirium and the pulse was weak; morphia and strychnia were injected hypodermically. There was no change on the 19th, but on the 20th the pulse was stronger. The patient had slept at night; and the urine was free from albumen. On the 21st the tongue was clean; the urine was still free from albumen, and the bubo was larger. On the 22nd the patient was worse; he had slept badly at night; the pulse was rapid and weak, and he vomited once in the morning; the bubo was very much larger, of the size of a large turkey's egg; the speech was slow and thick; there was still no albumen in the urine. Hypodermic injections of strychnia and ether were ordered. There was some diarrhœa during the afternoon and in the following night; this was checked, but not stopped, by astringents and starch and opium enemata. On the 23rd he had slept fairly well in the night; the diarrhœa continued; the tongue was clean, but the pulse weak. On the 24th the tongue was dry and the pulse weak; the respiration was rapid and shallow; the chest was normal the diarrhœa continued. On the 25th a red flush appeared over and round the bubo, and extended down the left thigh. On the 26th the erysipelatous redness was more marked, and had extended as far as the knee; there was a browny swelling of the whole thigh. The patient was put upon large doses of tr. ferri perchloridi, but without improvement, and death occurred on 27th March at 10 A.M., on the 13th day of the illness and the 9th day after commencing the serum treatment. The total amount of serum injected was 220 c.c.

CASE XXVII.—*Register No. 909.*—Dhondi Dhurma, Hindu, male, *aetat* 25; admitted 18th March, at 7 P.M., with a history of three days' illness.

State on admission.—Temperature 105°; pulse 160, weak; respiration 44. The patient is conscious and rational, but the speech is "thick." The spleen is not enlarged. The tongue is dry and coated with a yellowish, brown fur. There is a bubo in the right inguinal region.

Course of the illness.—On 19th March the patient was delirious and restless; the temperature was 102·4° at 6 A.M. and 104·5° in the evening; the urine contained much albumen. 40 c.c. of serum were injected. At 11 P.M. the temperature rose to 106·4°, the delirium became more marked, and the patient became weaker. Death occurred at 12-15 (midnight); on the fifth day of the disease and less than twelve hours after commencing the serum treatment. The total amount of serum injected was 40 c.c. (in one administration).

CASE XXVIII.—*Register No. 913.*—D. M. Monteiro, Christian, male, *ætat* 25, printer's compositor; admitted 19th March, at 9-30 A.M.

History.—At 2 P.M. on the previous day the patient was suddenly attacked with pain in the left groin. There was a rigor in the evening.

State on admission.—Temperature 103°; pulse 128, very weak; respiration 44. The conjunctivæ are lightly injected. The patient is semi-conscious; sleeps at times, but is at times delirious. The urine contains much albumen.

Course of the illness.—At 2 P.M. on the 19th March 40 c.c. of serum were injected. On the 20th the albuminuria was unaltered; the patient slept fairly well in the night; the temperature at noon was 104·4°; it fell at 6 P.M. to 100°. A second injection of 40 c.c. of serum was given. The patient died at 9-10 P.M. on the third day of the disease and 31 hours after commencing the serum treatment. He received in all 80 c.c. of serum.

CASE XXIX.—*Register No. 915.*—Sima Kara, Hindu, male, *ætat* 16, mill-hand; admitted 19th March, at noon.

History.—No accurate history of the illness could be obtained; but it was ascertained that he had been inoculated with Haffkine's prophylactic on 17th March two days before admission.

State on admission.—Temperature 104·4°; pulse 144; respiration 40. The tongue has the characteristic thick white fur on the dorsum, with pink and clean edges. The conjunctivæ are injected. The patient is unconscious, delirious, and at times violent. The speech is slow and "thick." The spleen is not enlarged. There is a large, diffuse, tender bubo in the left inguinal region.

Course of the illness.—The patient became very violent shortly after admission. He refused food, and had to be fed *per rectum.* The temperature fell to 101·2°, after the administration of 10 grains of phenacetin in hot rum and water, followed by 1 drachm of spirits of nitrous either. On 20th March 40 c.c. of serum were injected in the afternoon and 20 c.c. at night; the patient was extremely weak, the pulse was rapid and weak, and the respiration rapid and shallow. On the 21st he was drowsy and slept much. The tongue was dry and brown in the centre, with white fur on either side and pink edges. The pulse was 144 and rather stronger, respiration 22 and deeper than yesterday. Loud snoring rhonchi were heard on both sides of the chest. The urine could not be obtained for examination. 40 c.c. of serum were injected in the afternoon and 20 c.c. at night. Death occurred at 7 A.M. on 22nd March, on the fifth day after inoculation by Haffkine's prophylactic and on the second day after commencing the serum treatment. The total amount of serum injected was 120 c.c.

CASE XXX.—*Register No. 917.*—Lardoo Marothi, Hindu, male, *ætat* 27, labourer; admitted 19th March, at 7·30 P.M., with a history of two days' illness.

State on admission.—Temperature 101·8°; pulse 100, fairly good; respiration 36. The tongue is lightly furred. The spleen is not enlarged. The patient is conscious, and the speech is clear. The urine is acid and free from albumen. There is a small bubo in the right axilla. A few enlarged glands can also be felt in both groins, but these are not tender, and are probably chronic.

Course of the illness.—On 20th March an injection of 40 c.c of serum was given in the afternoon and one of 20 c.c. at 10 P.M. Two similar injections were given on the 21st; on this date there was troublesome vomiting; the tongue was drier and browner; there was still no albumen in the urine. At 8 P.M. I was hurriedly summoned to the ward by an attendant, who reported that the patient had thrown himself out of window. It appeared on enquiry that his bed had been found empty, and on search being made he was discovered, lying unconscious, on a ground-floor verandah or passage leading to the garden of the hospital. A steep *mehters'* staircase adjoined the ward in which he had lain, which was on the first storey, and it seemed almost certain that he had walked down the staircase and along to the verandah, which was at no great distance, had there collapsed and become unconscious from sudden heart failure. He had certainly not thrown him ut of window, as the verandah on which he was found was roofed over, and there were no fractures or other gross injuries, such as must have resulted from a fall of at least 25 feet. When seen, after being carried back to bed, the patient was deeply collapsed, quite unconscious, pulseless, and to all appearance moribund. The temperature, which at 6 P.M. had been 103°, had fallen to 98·4°, and at 6 A.M. on the following morning was 95·8. He rallied somewhat after the free exhibition of stimulants, and contrary to all expectation he began from this time onward to rapidly improve. There were five loose motions during the night. At 9 A.M. on the 22nd (the day after the *contretemps* described) he was conscious, and answered questions rationally; he had no recollection of the previous night's incidents. The tongue was cleaner, but very pale; the pulse was extremely weak; the speech slow and "thick"; the vomiting had ceased, and did not recur; the urine was still free from albumen; there was some cough, but the chest was normal. One injection of 10 c.c. of serum was administered. On the 23rd the general condition was greatly improved and the pulse much stronger; the temperature varied between 96·4° and 98°. On the 24th the bubo in the right axilla had completely disappeared. (From 25th March to 4th April I was absent.) On 4th April he was quite convalescent, and his general condition was excellent. He was discharged cured on 12th April. He received in all 140 c.c. of serum. The case is remarkable for the rapid and permanent improvement in all the symptoms which dated from the incident described—an incident which very nearly proved fatal. A case presenting some similar features will be found on page 14 of General Gatacre's Report upon Plague in Bombay in 1896-97, and an analogous case is described by Defoe in his History of the Plague in London (page 128 of Bohn's Select Library Edition, 1889).

CASE XXXI.—*Register No. 919.*—Mowlabux Alabux Muhammadan, male, *ætat* 25, *bheesty;* admitted 20th March, at 10-20 A.M., with a history of three days' illness.

State on admission.—The patient is delirious and restless. The tongue is coated, but moist. The conjunctivæ are injected. He is very noisy and talkative; the speech is slow and "thick". The urine contains albumen. There is a tender bubo in the left groin.

Course of the illness.—At noon on 10th March an injection of 40 c.c. of serum was given, and another of 20 c.c. at 10 P.M. Death occurred at 10-55 P.M. on the fourth day of the disease and eleven hours after commencing the serum treatment. He received, in all, 60 c.c. of serum.

CASE XXXII.—*Register No.* 925.—Dookhi Dubari Hindu, male, *ætat* 19, mill-hand; admitted 20th March, at 3-45 P.M., with a history of three days' illness.

State on admission.—The patient is conscious, but drowsy. The tongue is thickly coated, but moist and clean at the edges. The bowels are confined. There is some cough, but the chest is clear. The spleen is not enlarged. There is no headache or giddiness There is no albumen in the urine. There is a large, hard tender diffuse bubo in the right groin, measuring 4 inches by 2½ inches.

Course of illness.—On 20th March two injections of serum were given, of 40 c.c. and 20 c.c. respectively. The patient was violently delirious during the night. On the 21st two similar injections of serum were given. The urine was acid, and contained a light cloud of albumen. On the 22nd there was no change in the symptoms; 40 c.c. of serum were injected in the afternoon and 20 c.c at night. Death occurred at 11·50 P.M. on the sixth day of the disease and on the third day after commencing the serum treatment. The total amount of serum injected was 180 c.c.

CASE XXXIII.—*Register No. 927.*—Rustomjee Framjee, Parsee, male, *ætat* 67; admitted 20th March, at 10-15 P.M., with a history of illness since noon the previous day.

State on admission.—The tongue is characteristic and the conjunctivæ are deeply injected. The pulse is good. There is no cough. The spleen is not enlarged. The patient is conscious; he complains of headache and sleeplessness. In the groin is a hard, tender bubo, of the size of a pigeon's egg.

Course of the illness.—On 21st March 30 c.c. of serum were injected in the afternoon and 20 c.c. at night, and these doses were repeated on the following day. He had slept fairly well under sulfonal. On the 22nd he had also slept fairly well; the pulse was still good; the highest temperature was 104°; the bubo was unaltered. A small furuncle had appeared, about one inch to the right of and below the umbilicus. The urine contained a slight cloud of albumen. On the 23rd the tongue was cleaner and the pulse still good. The bubo was rather larger. A red flush had appeared round the furuncle on the abdomen. During the afternoon the patient complained of much pain and tenderness on the right side of the abdomen; the red flush had extended from the furuncle over the right side of the abdomen and into the iliac fossa, and there was marked cutaneous œdema over the same area, extending to and involving the skin over the bubo, and giving a marked prominence to the right side of the abdomen over the left. The whole area was very painful and tender. The temperature at 6 P.M. was 104·5°. There was some diarrhœa, and in the evening delirium. The urine still contained albumen. 40 c.c. of serum were injected on this day. On the 24th the patient was delirious and violent; he had slept little in the night. The cutaneous redness and œdema were rather less. The albuminuria had increased. The bubo was unaltered. 40 c.c. of serum were injected in the afternoon and 20 c.c. at night. On the 25th the redness and œdema again increased; the diarrhœa ceased; the urine still contained albumen. 40 c.c. of serum were injected. Death occurred at 4-30 P.M. on the eighth day of the disease and the fifth day after commencing the serum treatment. He received in all 250 c.c. of serum.

CASE XXXIV.—*Register No. 929.*—Gopal Shonset, Hindu, male, *ætat* 23; admitted 21st March, at 12-30 (noon), with a history of four days' illness.

State on admission.—The tongue is thickly coated with a dry, brownish-white fur. The conjunctivæ are injected; the pupils dilated, but not widely. The patient is semi-conscious and delirious. The spleen is enlarged, dulness extending to the anterior axillary line in front and almost to the edge of the ribs below. Sibilant rhonchi are heard over both sides of the chest posteriorly. The urine is acid, and contains much albumen. There is a wound with much surrounding ecchymosis over the left eyebrow; this was the result of his falling out of the *gharri* on his way to the hospital.

Course of the illness.—On the day of admission 40 c.c. of serum were injected in the afternoon and 20 c.c. at 10 P.M. On the following day 40 c.c. were injected. The highest temperature was 105° at 6 P.M. Death occurred at 7-25 P.M. on 22nd March, on the sixth day of the disease and on the second day after commencing the serum treatment. He received in all 100 c.c. of the serum.

CASE XXXV.—*Register No. 939.*—Beni Mangoe, Hindu, male, *ætat* 50; admitted 23rd March, at 7-20 P.M., with a history of three days' illness.

State on admission.—The patient is semi-conscious and delirious. The conjunctivæ are deeply injected. The pulse is fairly good. The spleen is not enlarged. The chest is normal, and there is no cough. The bowels are confined. The left supratrochlear gland is much enlarged and painful, and there are swelling, pain, and tenderness of the whole left upper arm.

Course of the illness.—On 24th March the urine contained a light cloud of albumen. The highest temperature was 105° at 6 P.M. 40 c.c. of serum were injected at noon. On the 25th 40 c.c. were injected in the afternoon and 20 c.c. at night. The delirium continued. On the 26th the patient was violently delirious, and refused food. Death occurred at 1-55 P.M. on the sixth day of the disease and on the third day after commencing the serum treatment. He received in all 100 c.c. of serum.

CASE XXXVI.—*Register No. 935.*—Mahomed Hossain, Muhammadan, male, *ætat* 35, mendicant; admitted 22nd March, at 11-10 A.M., with a history of two days' illness and of repeated previous attacks of malarial fever.

State on admission.—The tongue is lightly furred and moist. The patient is apathetic, but at times violent and delirious. The conjunctivæ are deeply injected. The pulse is good. The spleen is much enlarged, extending beyond the margin of the ribs, and easily palpable through the abdominal walls. The lungs are normal. The patient is a confirmed opium-eater, and, as stated above, a malarial subject. There is a bubo the size of a hen's egg in the left femoral region, not prominent, and rather diffuse (that is to say, the edges are not sharply defined owing to surrounding infiltration).

Course of the illness.—The temperature on 22nd March varied between 97° and 101°; 40 c.c. of serum were injected in the afternoon and 20 c.c at 10 P.M. On the 23rd 40 c.c. were injected, and this was repeated on the 24th. On the latter date the urine was free from albumen in the morning, but contained a light cloud in the afternoon. The mental state and the condition of the bubo were unaltered. On the 25th the urine was free from albumen. (From 25th March to 4th April I was away.) The patient was removed to the convalescent ward on 26th March. On the 30th the urine was bloodstained, and hamamelis was adminstered internally; on the following day gallic acid and ergot were substituted for the hamamelis. On 4th April the urine was found to be alkaline, and with the marked smoky tinge characteristic of the presence of blood, and giving a thick deposit on standing. Microscopically the deposit was seen to be made up of phosphates, red blood corpuscles in large numbers, a few leucocytes, some irregular, flat epithelial scales with nuclei and many very actively moving micrococci and rod-shaped bacilli. There were no tube-casts. Micturition was painful and frequent (about once every hour); the supra-pubic region was painful and tender. The cystitis was relieved by hot fomentations to the lower part of the abdomen and the administration of liq. potassae, tr. hyoscyami, potassii bromid., and spiritus ætheris nit. On 5th April the condition was much improved; micturition was less painful and performed only four times throughout the day. On 7th April the urine was acid; it contained a small number of red blood corpuscles, but was otherwise normal. On the 8th the patient complained of pain in the lower part of the front of the chest, and there was considerable tenderness over the xiphi-sternum. The heart and lungs were quite normal. The pulse was weak, the tongue moist and lightly furred. The pain was relieved by a mustard poultice. He was now on a mixture containing bicarbonate and nitrate of potash, strychnia, belladonna, and spirits of nitrous æther. On the 10th April the pain had nearly disappeared. The general condition was much improved; the pulse was stronger; perspiration at night was complained of. On the 11th the pain had gone, the urine was normal, and micturition painless, regular and not abnormally frequent. On the 12th the pain returned over the sternum; the chest was still normal; the tongue was pale, furred, moist and indented by the teeth; the temperature was normal. The pain was relieved by a belladonna plaster, but it continued to recur at intervals. On 3rd May (when I left Parel) there was still occasional pain, and some swelling remained in the left femoral region. (The bubo had not suppurated.) In all other respects the patient was ready to be discharged. This patient received in all 140 c.c. of serum.

Case XXXVII.—*Register No. 945.*—Atmar Luximon Hindu, male, *ætat* 22 carpenter; admitted 24th March, at 4-10 P.M., with a history of four days' illlness, the initial rigor having occurred on the 20th.

State on admission.—Temperature 104°. The tongue is coated, but moist; the tip and edges are clean. The patient is conscious, but drowsy. There is a tender bubo in the left groin.

Course of the illness.—On 25th March 40 c.c. of serum were injected. The urine was free from albumen. On the 26th 40 c.c. of serum were injected in the afternoon and 20 c.c at night. The urine was still free from albumen; the temperature varied between 103° and 104·2°. Death occurred at 8-30 A.M. on 27th March, on the seventh day of the disease and on the second day after commencing the serum treatment. The total amount of serum injected was 100 c.c.

Case XXXVIII.—*Register No. 952.*—Budhia, Hindu, female, *ætat* 7½; admitted 25th March, at 2-50 P.M., with a history of nine days' illness.

State on admission.—Temperature 102°; pulse 124 intermittent, respiration 62. The patient is drowsy. The bowels are confined. There is a very large, hard, diffuse bubo in the right cervical region.

Course of the illness.—During the afternoon and evening vomiting was troublesome; nothing could be retained. On 26th March the vomiting ceased; 5 c.c. of the serum were injected in the afternoon and 5 c.c. at night. These doses were repeated on the following day. On the 27th the highest temperature was 100°; owing to the position and size of the bubo the mouth could scarcely be open, and feeding was difficult. On the 28th and 29th there was little change; the bubo remained hard. On the 30th there were signs of softening in the bubo and an incision was made in the anterior portion, but no pus was obtained. On 2nd April a second incision was made in the posterior portion, and a considerable quantity of pus was evacuated. The bubo continued to discharge until the 14th, when all discharge ceased, and the wound began to heal. The patient left the hospital cured on 27th April. The total amount of serum administered was 20 c c.

* Case XXXIX.—*Register No 954.*—Luximon, Hindu male, *ætat* 25, millhand; admitted 25th March, at 9-45 P.M., with a history of one day's illness.

State on admission.—Temperature 105; pulse 124, respiration 32. The tongue is dry and thickly coated. The patient is unconscious. There is a tender, hard bubo in the right groin.

Course of the illness.—On 26th March 40 c.c of serum were injected in the afternoon and 20 c.c. at night. The urine was free from albumen. On the 27th 40 c.c. of serum were injected. Death occurred at 4-55 P.M. on the third day of the disease and on the second day after commencing the serum treatment. The total amount of serum injected was 100 c.c.

* Case XL.—*Register, No. 959.*—Lallo Abid Hossain, Muhammadan, male, *ætat* 22, labourer, admitted 26th March, at 3-30 P.M., with a history of six days' illness.

State on admission.—Temperature 99·6°, pulse 114, respiration 30. Tongue moist and lightly furred. The skin is dry and hot. There is a tender bubo in the right femoral region; it appeared four days ago.

Course of the illness.—The temperature at 6 P.M. rose to 103°. On 27th March 40 c.c. of serum were injected in the afternoon and 20 c.c. at night. The patient was delirious and violont in the evening. The urine contained a light cloud of albumen. On the 28th the albumen had increased; vomiting occurred once, the vomit containing a round worm. 40 c.c. of serum were injected in the afternoon and 20 c.c. at night, and similar injections were given on each of the two following days. On the 29th the urine was free from albumen; delirium was still troublesome. On the 30th the temperature, which at the highest had not exceeded 103°, was falling; it reached normal on 3rd April and did not again rise. On 7th April the bubo was quite small, and there was a small healing ulcer over it. It had not suppurated. He was discharged cured on 2nd May. The total amount of serum injected in this case was 240 c.c

*Case XLI.—*Register No. 926.*—Narayan, Hindu, male, *ætat* 12; admitted 26th March, at 6 P.M.

History.—The onset occurred with rigors at 10-30 P.M. the previous evening.

State on admission.—Temperature 104°, pulse 136, weak, respiration 50. The skin is dry and hot. Rhonchi are heard over both lungs; there is no cough. The spleen is not enlarged. There is no bubo.

Course of the illness.—An injection of 20 c.c. of serum was given at 10 P.M. on 26th March. The patient was then very noisy and delirious. On the morning of 27th March he was extremely delirious, and was with great difficulty kept recumbent. At 9-30 A.M. he slept, under morphia. The pulse was better, 120 per minute; the respiration 28 and quiet; the pupils were moderately contracted. A bubo had appeared in the left axilla. The urine was drawn off by catheter. Twenty c.c. of serum were injected at noon and 10 c.c. at 10 P.M. The temperature at 6 P.M. was 103°. On the 28th there was still delirium and restlessness. The stools were loose and offensive; the urine contained much albumen. 10 c.c. of serum were injected at 2 P.M. Death occurred at 6-35 P.M. on the third day of the disease and 44½ hours after commencing the serum treatment. The total amount of serum injected was 60 c.c.

* Case XLII.—*Register No. 966.*—Sebastian Pedro, Christian, male, *ætat* 30, labourer; admitted 27th March, at noon, with a history of illness since the previous evening.

State on admission.—Temperature 102·6°; pulse 124; respiration 40. The tongue is coated, the conjunctivæ injected and the skin is hot and dry. Two loose motions occurred shortly after admission. There is a bubo in the left groin; the skin over it is ulcerated and sloughing.

Course of the illness.—On 28th March, at 11 A.M., 40 c.c. of serum were injected. The urine contained a very large quantity of albumen. Death occurred at 2-30 P.M. on the second day of the disease and 3½ hours after the first and only injection of 40 c.c. of serum.

* Case XLIII.—*Register No. 970.*—Ramchunder Ragoo, Hindu, male, *ætat* 21; admitted 28th March, at 11-5 A.M. with a history of three days' illness.

State on admission.—Temperature 103°; pulse 124, weak; respiration 36. The tongue is coated, the skin hot and dry, and the conjunctivæ are injected. The bowels are confined. There is a tender bubo in the right groin. The urine contains much albumen.

Course of the illness.—On the day of admission 40 c.c. of serum were injected at noon and 20 c.c. at 10 P.M.

Note.—The cases marked with an asterisk were admitted during my temporary absence from Parel. The male cases during this interval were under the care of Dr. Castellote, M.D.

Similar injections were given on 29th March. On 30th March the patient was noisy and delirious ; the pulse was almost imperceptible ; the urine still contained much albumen. Death occurred on the 31st, at 11 A.M., on the sixth day of the disease and three days after commencing the serum treatment. The total amount of serum injected was 120 c.c.

* CASE XLIV.— *Register No. 973.*—Bappo Ramjeet, Hindu, male, *ætat* 28, labourer ; admitted 29th March, at 12-20 (noon), with a history of illness since 3 P.M. on the previous day.

State on admission.—The tongue is thickly coated with white fur; the edges are clean and red. The skin is hot and dry and the pulse rapid and weak. The speech is slow and "thick". There is some cough. The urine is dark and smoky from the presence of blood ; it contains much albumen. There is a tender bubo in the left groin.

Course of the illness.—On 29th March 40 c.c. of serum were injected in the afternoon and 20 c.c. at 10 P.M. On the 30th the patient was collapsed and the temperature subnormal ; the urine was unaltered. On the 31st the patient was almost pulseless and the extremities were cold. Death occurred at 6-25 P.M. on the fourth day of the disease and on the third day after commencing the serum treatment. The total amount of serum injected was 60 c. c.

* CASE XLV.—*Register No. 980.*—Balu Hari, Hindu, male, *ætat* 28, mill-hand ; admitted 30th March, at 9-40 A.M., with a history of five days' illness.

State on admission.—Temperature 103°, pulse 114, respiration 30. The patient is conscious ; the skin is dry and hot, the urine is free from albumen. There is a bubo in the right femoral region.

Course of the illness.—On the day of admission 40 c.c. of serum were injected at noon and 20 c.c. at 10 P.M., and these doses were repeated on each of the four succeeding days. On 31st March the highest temperature was 101° ; the patient slept and took his food well ; the urine was still free from albumen. On 1st April albumen appeared in the urine ; on the 2nd and 3rd it was present in still larger quantities. The temperature on the 2nd varied between 99° and 104°, and on the 3rd between 101° and 104°. Death occurred at 10 A.M. on 4th April, on the tenth day of the disease and on the fifth day after commencing the serum treatment. The total amount of serum injected was 300 c.c.

* CASE XLVI.—*Register No. 988*—Kushia Narayan, Hindu, male, *ætat* 23 ; admitted 31st March, at 1-50 P.M., with a history of five days' illness.

State on admission.—The patient is conscious. He is slightly delirious at times, but answers questions rationally. The speech is very indistinct. The pulse is fairly good ; the lungs are normal, and the spleen is not enlarged. The urine contains albumen. There is a bubo in the left axilla ; the skin over it is ulcerated, the result of some native caustic application.

Course of the illness.—On 31st March 40 c.c of serum were injected in the afternoon and 20 c.c. at 10 P.M. These doses were repeated on the following day. On 31st March the temperature varied between 101° and 103°, and on 1st April the limits were 100° and 102·6°. The urine still contained albumen on the 1st. Death occurred at 9-20 A.M. on 2nd April, on the seventh day of the disease and on the second day after commencing the serum treatment. The total amount of serum injected was 120 c.c.

* CASE XLVII.—*Register No. 997.*—Balu Gunput, Hindu, male, *ætat* 33, mill-hand ; admitted 1st April, with a history of illness since noon on the previous day.

State on admission.—Temperature 103·6°, pulse 144, respiration 40. The tongue is lightly coated. There is a small, tender bubo in the left femoral region.

Course of the illness.—The temperature rose at 6 P.M. on 1st April to 104·5°. On 2nd April the urine was acid, and contained albumen. 40 c.c. of serum were injected in the afternoon, and 20 c.c. at night. On the morning of 3rd April the patient was very restless and noisy, and the pulse was very weak. Death occurred at 9-15 A.M., on the third day of the disease and in less than 24 hours after commencing the serum treatment. The total amount of serum injected was 60 c.c.

* CASE XLVIII.—*Register No. 1001.*—Musiban Shaik Chand, Muhammadan, female, *ætat* 25, mendicant ; admitted 2nd April, at 3-10 P.M. Duration of illness unknown.

State on admission.—Temperature 100·8° ; pulse 120, irregular ; respiration 34. The tongue is thickly furred, the skin is moist. The patient is apathetic and delirious, the speech is very indistinct ; the bowels are confined. The left eye is quite disorganised, the cornea is perforated, and the sclerotic thin in places. There is no bubo.

Course of the illness.—On 3rd April a bubo appeared in the left axilla. The urine was found to contain much albumen. The lungs were normal. 40 c.c. of serum were injected in the afternoon and 20 c.c at 10 P.M. On 4th April another injection of 40 c.c. was given. Crepitations were heard over the bases of both lungs and extending into the right axilla. At 10 P.M. the temperature rose to 104·8 ; the patient was quite unconscious ; respiration was shallow and gasping, and the pulse almost imperceptible. Death occurred at 10-40 P.M. on the second day after commencing the serum treatment. She received in all 100 c.c. of serum.

* CASE XLIX.—*Register No. 1004.*—Sitaram Bicajee, Hindu, male, *ætat* 22, mill-hand ; admitted 2nd April, at 6-45 P.M., with a history of three days' illness.

State on admission.—Temperature 105° ; pulse 112 ; respiration 28. The tongue is moist and thickly coated ; the conjunctivae are injected, and the patient is drowsy. There is a hard, tender bubo in the left groin.

Course of the illness.—On 3rd April the temperature varied between 102° and 104·6° ; the urine contained a small quantity of albumen. 40 c.c. of serum were injected at noon and 20 c.c. at night. On 4th April the albumen in the urine had increased ; the injections of serum were repeated ; the temperature varied between 103° and 104·2°. On 5th April I found him in the following state : the tongue was coated with a whitish grey fur, especially thick over the posterior half ; the conjunctivæ were lightly injected ; the pulse was very weak. The patient was conscious ; the speech was fairly clear, but the voice was weak. The spleen was not enlarged ; there was no cough, but rhonchi were heard over both lungs posteriorly. At noon the temperature rose to 104·6°, and death occurred shortly after, on the sixth day of the disease and on the third day after commencing the serum treatment. The total amount of serum injected was 120 c.c.

CASE L.—*Register No. 1011.*—Naizureddin Ibrahim, Muhammadan, male, *ætat* 40 ; admitted 4th April, at 9-20 A.M., with a history of two days' illness.

State on admission.—Temperature 103·6° ; pulse 114, fairly good ; respiration 38. The tongue is lightly furred and moist. The conjunctivæ are markedly injected. The spleen is not enlarged, and there is no cough. The patient is conscious, but the speech is very slow and "thick". The urine contains a small quantity of albumen. There is a hard, tender, prominent, well-defined bubo, of the size of a hen's egg in the right groin.

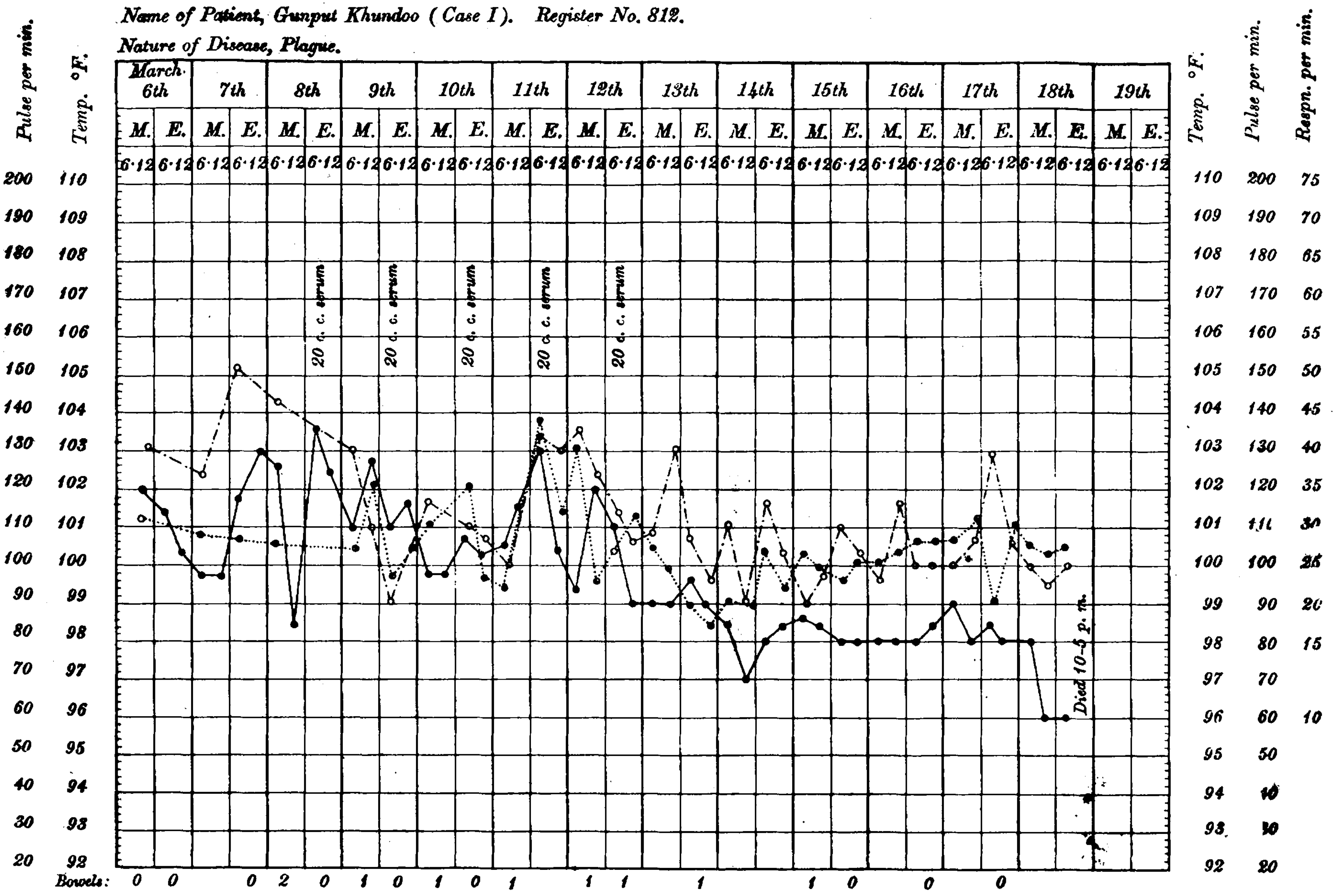
Course of the illness.—On 4th April 40 c.c. of serum were injected at noon and 20 c.c at 10 P.M., and these doses were repeated on the following day. The highest temperature on the 4th was 105·4° at noon. The albuminuria was greater on the 5th. On the 6th some diarrhœa occurred in the afternoon ; the temperature varied between 103° and 104·4°. 40 c.c. of serum were injected in the afternoon. The pulse was rather stronger. On the 7th the pulse became weaker again ; the patient was extremely apathetic, but he was conscious and appeared to understand questions. He endeavoured to reply to them, and the lips formed words, but he was too weak to produce any sound. Death occurred at half-an-hour after midnight, on the morning of 8th April, on the sixth day of the disease and the fourth day after commencing the serum treatment. The total amount of serum injected was 160 c.c.

NOTE.—The cases marked with an asterisk were admitted during my temporary absence from Parel. The male cases during this interval were under the care of Dr. Castellote, M.D.

HOSPITAL CHART OF TEMPERATURE, PULSE & RESPIRATION.

Name of Patient, Gunput Khundoo (Case I). Register No. 812.

Nature of Disease, Plague.



REMARKS.

The injections of serum were not administered at the hour of 6 or 12, morning or evening, as might appear from the chart, but within the six hour period, ending at the hour under which the entry is made on the chart.

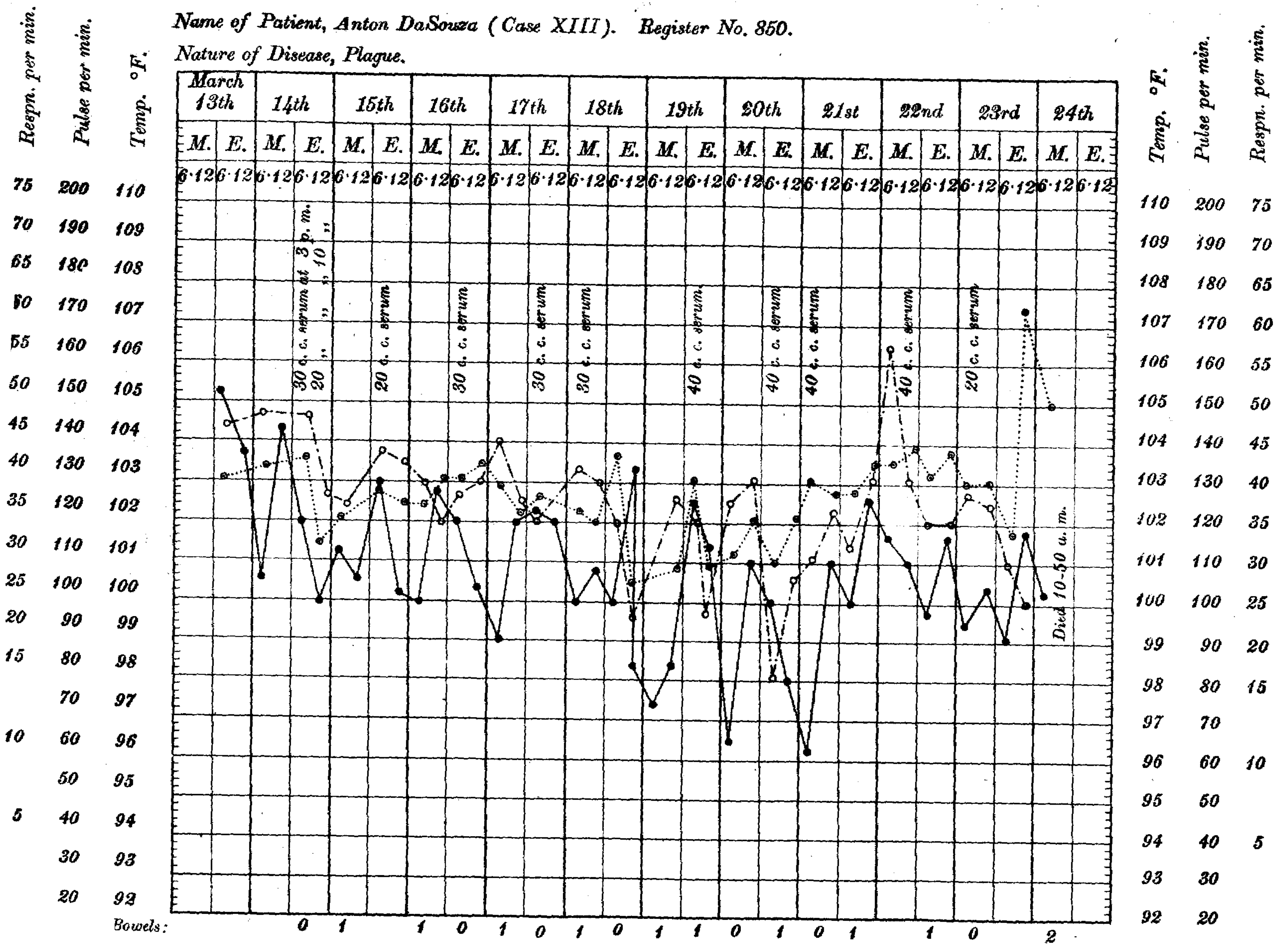
Litho. S. I. O., Calcutta.

Appendix XXII.

HOSPITAL CHART OF TEMPERATURE, PULSE & RESPIRATION.

Name of Patient, Anton DaSouza (Case XIII). Register No. 850.

Nature of Disease, Plague.



REMARKS.

The injections of serum were not administered at the hour of 6 or 12, morning or evening, as might appear from the chart, but within the six hour period, ending at the hour under which the entry is made on the chart.

Appendix XXII.